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THE TYPE OF THE NEW BREED—"LAMONA"

The best egg markets in the country show a preference for *white-shelled* eggs. Yet, at the present time, all of our "general purpose" breeds of poultry are layers of *brown-shelled* eggs. White-shelled eggs are laid by hens of the Mediterranean breeds, such as the White Leghorn, but this breed does not produce meat as the Plymouth Rock does. How a new breed has been "made to order," combining the desired qualities of meat and white egg production is told in the following pages.

Not the least interesting feature of this investigation is that it is one of the first attempts to do under scientific control conditions what poultry breeders have frequently done in practice—to develop a new breed by blending desired characters from two or more established breeds. Three breeds were used—the White Plymouth Rock, the Single Comb White Leghorn and the Silver Gray Dorking.

This picture shows a crossbred female (No. 6008) hatched in 1919. It has a red ear lobe and lays a white-shelled egg. Note the length of body, capacity for egg production, and great length of breast. To date this hen combines in the greatest degree the many characters sought by the originator. (Frontispiece)

LAMONA—A NEW BREED OF POULTRY

A New General Purpose Breed of Fowl Developed by Blending the Egg Producing and Meat Producing Characters from Three Established Breeds

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Bureau of Animal Industry, U. S. Department of Agriculture

AT THE present time all of our general purpose breeds of chickens are layers of brown eggs. At the same time some of the best markets of the country show a preference for white-shelled eggs and pay an increased price for them, which is an important consideration to the man who is producing market eggs on a commercial scale. The color of the eggs produced has, therefore, been one of the factors which has induced practically all large specialized poultry farms to keep White Leghorns or some similar egg breed. This has not been the only factor of course, the matter of feed consumed by the fowls and the consequent economy of production playing an important part where all of the feed has to be purchased, and there is little opportunity for the fowls to pick up any part of their own living.

So far as the general farm flock is concerned—which usually consists of a relatively small number of hens given their range about the farmstead where they are able to pick up at certain seasons of the year a considerable portion of the feed which they need—the situation is somewhat different. Such flocks are maintained not only for the purpose of supplying eggs for the farmer's table and a certain surplus which can be sold at market prices, but also for the purpose of supplying occasional table fowls. On this account our general purpose breeds are better suited to the farmer's needs because they provide a much better fowl for eating purposes; but here again, in those sections of the country which are situated within fairly close shipping distances to the large markets, and which therefore have an opportunity to put eggs into these markets and get the top prices for them, that the general purpose breeds lay a brown-shelled egg has resulted in many instances in the farm flocks consisting of one of the egg breeds. This can be readily noticed in the states immediately surrounding New York City, since most of the eggs produced by these farm flocks eventually find their way to that market which is a white egg market. The actual situation, therefore, is that in some sections of the country, farmers are maintaining for their flocks of chickens one of the egg breeds, simply on account of the color of the egg which they lay, when one of the general purpose breeds would really be better suited to their purpose if they only laid a white egg. It will be seen therefore that there is a distinct place

Note: The story told in this article is one which will be interesting to breeders and students of genetics, and fascinating to the layman. It is seldom that we are able to outline in all details the various steps taken to perfect one of our improved breeds of animals. Mr. Lamon has told that story in detail. The breed has progressed far enough so that type and various characters, such as color, the red earlobe and the white-shelled egg, have been fixed. The Department of Agriculture regards this work as a noteworthy achievement in breeding and, without solicitation on his part, has named the new breed for the man who developed it. To name new species of plants, animals and micro-organisms for the discoverer is quite common. The development of a useful breed of domestic animal may be quite as useful to the welfare of mankind. The conception of the project for the development of this breed of poultry was Mr. Lamon's, and every mating has been made by him. The Secretary of Agriculture therefore approved on April 23, 1921 the recommendation of the Chief of the Bureau of Animal Industry that the new breed be officially designated "Lamona."—GEO. M. ROMMEL, Secretary, American Genetic Association.

SILVER GRAY DORKING HEN—MOTHER OF THE NEW BREED

This is the hen, presented to the Department of Agriculture by Mr. Jacobus, which was bred to a White Plymouth Rock male in the original mating in 1912. The Dorking gave the rectangular body shape, long breast bone and good thick flesh; and it has a red ear lobe and single comb. The characters of the Dorking which had to be eliminated were color, the fifth toe, the white legs and the brown shelled egg. The fifth toe is a useless appendage, and therefore desired out. It is shown well in Figs. 6 and 9. (Fig. 1.)

in our present poultry population for a breed having the larger size and some of the other characteristics of our general purpose breeds, and at the same time laying white-shelled eggs.

THE PROBLEMS OF A NEW BREED

With this situation existing, the problem became one of attempting to establish a new breed which should recombine some of the qualities of the general purpose and the egg breeds, and which should produce a fowl better suited for the general farm flock in those sections of the country where a white egg has the preference. What was desired in such a bird and what was contemplated therefore in the experiment described here, was to secure a fowl having white plumage, yellow skin, yellow beak and legs, but at the same time having a larger body than the Leghorn, and of such a type as to be a better meat fowl. Later I decided to fix on this fowl a red ear lobe so that it would be readily differentiated from any of the larger type Leghorns. However, my desire was to produce a breed which should lay a white egg.

At this point I wish to make acknowledgment of the assistance of Mr. Rob R. Slocum, Poultryman of the Animal Husbandry Division, U. S. Department of Agriculture, who has assisted me in keeping the records and compiling various data.

THE ORIGINAL PROJECT

Objects: To produce a breed of fowls of two varieties having the shape, size and market qualities of the Dorking, with a yellow skin, white plumage, and four toes, and that will lay a large, white egg.

Method of Procedure:

1st Year: A low-stationed, close-feathered White Plymouth Rock male and a Silver Gray Dorking female that lays a large, white-shelled egg will be mated.

A Single Comb White Leghorn male having a rather small, low comb, and a Silver Gray Dorking female that lays a large, white-shelled egg will be mated.

THE WHITE PLYMOUTH ROCK WAS ONE OF THE SOURCES OF THE NEW BREED

This photograph shows a male bird which is typical of the original bird used in the first mating of White Plymouth Rock—Silver Gray Dorking in 1912. The White Plymouth Rock gave characters of weight, flesh, yellow legs, single comb, color and four toed feet which were desired and also the red ear lobe which was wanted in order to readily distinguish the new breed from heavier types of White Leghorn. But it also gives a brown-shelled egg which character was to be eliminated. (Fig. 2.)

2nd Year: The offspring of these crosses will be mated separately, the females trap nested, and only the high producers of the largest and whitest shelled eggs used for breeders. Only male birds from high-producing females will be used.

3rd Year: The mating of the results of the crosses of the 2nd year to be brought about by using the same methods of selection, and, in addition, care taken to secure white specimens with yellow skins having only four toes.

A Rose Comb White Leghorn male

IN THE SECOND YEAR OF THE WORK (1913) THE LEGHORN BLOOD WAS ADDED

This picture shows the kind of single comb white males which were mated with the Silver Gray Dorking hens in the original mating known as pen 18. The characteristics desired from the Single Comb White Leghorn cross were the single comb, color of plumage, yellow legs, white shelled egg, heavy laying quality and the four toed feet. The characters to be eliminated were the rangy conformation, light covering of flesh and the white ear lobe. The last named character was expected to be the most difficult problem and events justified the expectation. Note the later pictures illustrating this point. (Fig. 3.)

will also be mated with some of the above offspring to procure a Rose Comb variety of the breed.[1]

From this time on the perfecting of the breed will be done by selection of the best individuals, care being taken not to inbreed too closely so that the constitutions of the foundation stock will not be impaired. Careful record will be kept of each step in this work, and photographs taken of many of the specimens used.

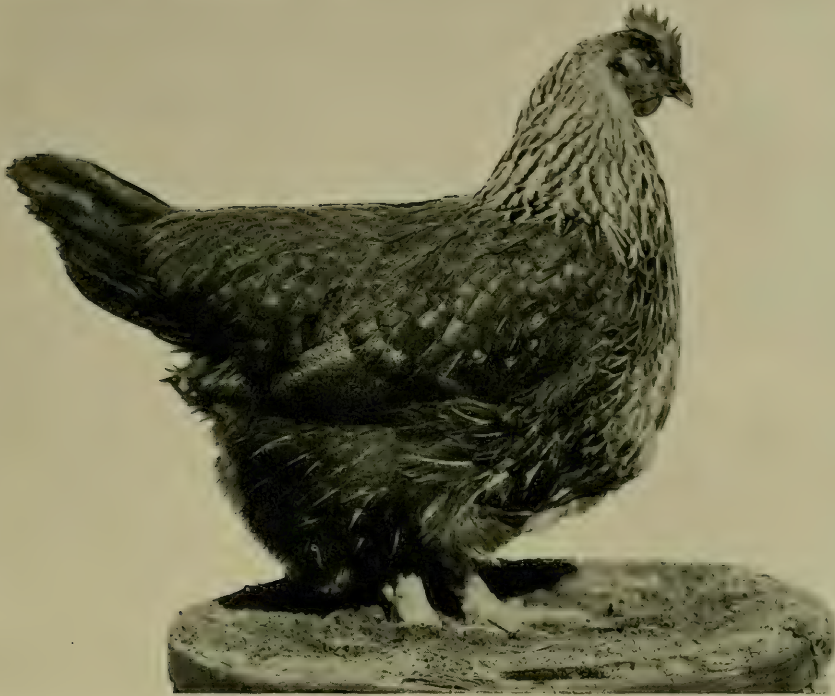
TIME AND PLACE OF STARTING THE EXPERIMENT

The effort to solve this problem was begun in the spring of 1912. At that time preliminary matings were made at the Government poultry farm, Beltsville, Md., and the work has since been carried on entirely at that location.

BREEDS AND VARIETIES USED

Three varieties, each of a different breed, were selected as having the va-

[1]Up to the present time I have not undertaken to make the Rose Comb variety of this new breed.



A DORKING HEN SHOWING STRONGLY ITS RECTANGULAR SHAPE, DEPTH OF BODY, AND LONG BREAST BONE

This is one of the Silver Gray Dorking hens bred to a Single Comb White Leghorn male in 1913. It was one of the Westfall birds purchased in 1913, and the mating is known as pen No. 18. The Dorking is widely known for its desirable table qualities. (Fig. 4.)

rious characters which were desired in the offspring and by crossing these together it was hoped to be able to recombine them in the manner desired. The three varieties used for this purpose were the Silver Gray Dorking, the White Plymouth Rock and the White Leghorn.

The Dorking fowl is of English origin and in England is considered one of their finest table fowls. The White Plymouth Rock is of American origin and is considered not only a splendid table fowl in this country but also a good egg producer. The White Leghorn is of Italian origin and is considered among the very best of the egg producing breeds.

The Dorking is a long-bodied, low set bird, possessing a prominent breast and having in general an outline of body which is decidedly rectangular. The Dorking may be said to be almost an idea' meat type. The size is also good, the standard weights being as follows: cock 8 lbs., hen 6½ lbs., cockerel 7 lbs., pullet 5½ lbs. It was to secure this long-bodied, lower set type and general table quality that the Silver Gray Dorking was used in this cross.

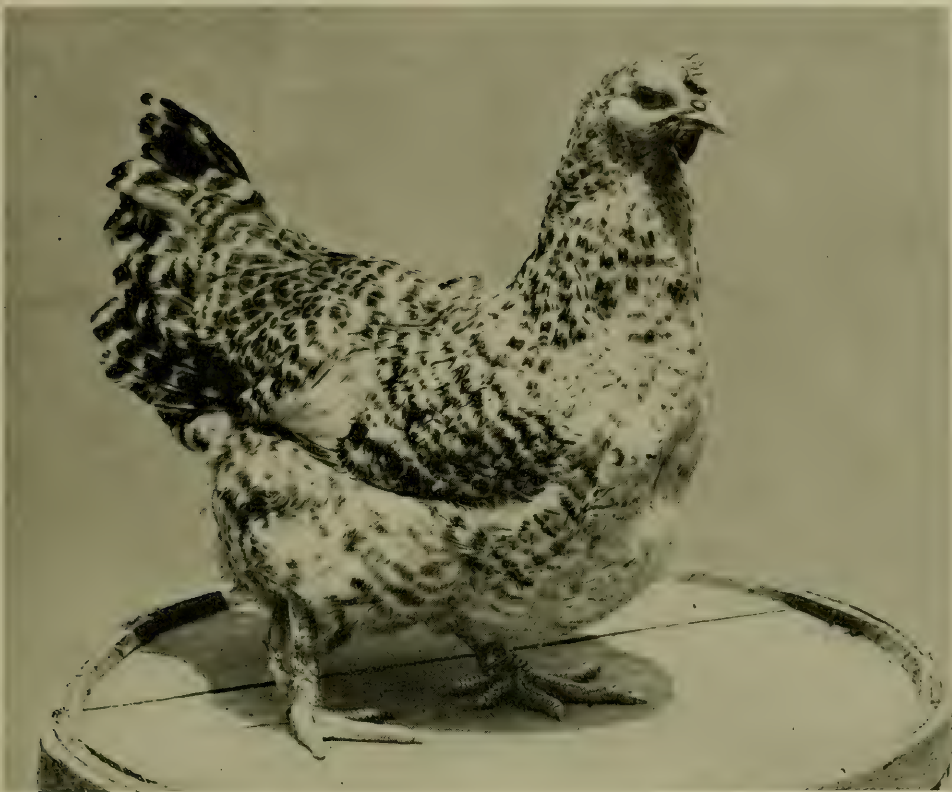
This variety, however, possessed certain other qualities which would be undesirable in the final product and which it became necessary to eliminate by proper selection in breeding. The first of these is the color of plumage. The male of this variety has a silver white hackle, shoulders, back and saddle. The rest of the plumage is black except for some white in the wing. The female has a silver white neck, each feather being striped with black. The general body color is silver white stippled or dotted with ashy gray which

A FIRST GENERATION HYBRID FROM THE WHITE PLYMOUTH ROCK-DORKING MATING OF 1912

In first crosses, characters are often thrown up from the depths of the stream of inheritance which do not appear on the surface. This pullet shows poor Barred Plymouth Rock markings. She was used in breeding pen 22 in 1913. She has four toes, a Plymouth Rock character. (Fig. 5.)

gives a general softer gray cast to the plumage. The breast and front of the neck are salmon color. The undercollar of both sexes is slate. Another characteristic of the Silver Gray Dorking which was undesirable was the possession of a fifth toe. This toe grows at the rear of the shank coming out just above the rear fourth toe and curving upward. A further undesirable quality of this variety is the white color of leg. This is a drawback in this country, from the fact that the buying public prefers a yellow skin and yellow legs in the fowls which they purchase for consumption. The English market prefers fowls having white skin and legs. The color of the egg laid is neither white nor brown but is intermediate between the two and can best be described as a tinted egg. The color of ear lobe in this breed should be a solid red but in many instances is mixed with white.

The White Plymouth Rock used in the cross possesses, as its name would indicate, the desired quality of white plumage. It is also of good size, the standard weights being: cock 9½ lbs., hen 7½ lbs., cockerel 8 lbs., pullet 6 lbs. The birds of this breed, however, stand somewhat higher on legs and, while a good table type, do not approach what was desired in the new breed quite so closely as does the Dorking. The table quality of the Plymouth Rock is also good. It possesses the yellow skin, legs and beak, the solid red ear lobe and the fourth toe which were desired. The most objectionable quality of this variety is the fact that it produces a brown



ANOTHER FIRST GENERATION HYBRID PULLET OF SAME MATING AS FIG. 5

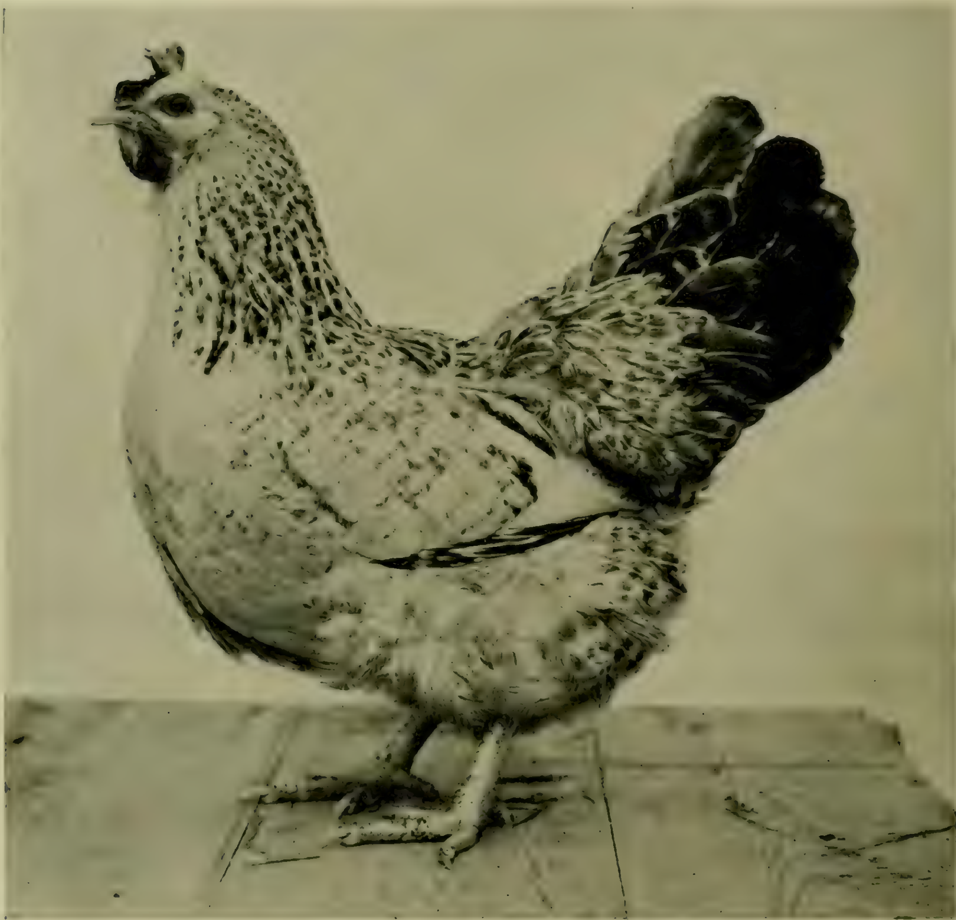
This bird is much lighter in color, shows some barring, and has five toes on each foot and is of a decided Dorking type in contrast with her sister shown in Fig. 5 who inherited the Plymouth Rock characteristics. This hen was also used in breeding pen 22, 1913. (Fig. 6.)

egg. To eliminate that quality has proved to be one of the most difficult problems of the whole breeding operation.

The third and final variety used in the crosses was the Single Comb White Leghorn. Like the White Plymouth Rock this variety possesses white plumage, yellow legs and skin and the normal four toes, all of which are desired characteristics. It is on this variety also that reliance had to be placed in order to secure the white egg color so much desired. The white ear lobe which this variety carries was a character not desired and one which had to be selected against constantly in order to secure its elimination. In addition, the White Leghorn is of too leggy a type and of too small size, the standard weights being: cock 5½ lbs., hen 4 lbs., cockerel, 4½ lbs., pullet 3½ lbs.

HOW THE BREEDS WERE USED

The first step in establishing this new breed was taken in 1912. It consisted of mating a White Plymouth Rock cockerel weighing nine pounds and having a low, well serrated six-point comb, rich red eye, absolutely white in surface and undercolor, good length of back, low well spread tail and body well placed on good strong rich yellow legs, with a Silver Gray Dorking female which was typical in shape except that she carried her tail too high and was a trifle light in weight, weighing six pounds. Her eye color was bright red, ear lobes red, legs white, with five toes on each foot. This hen laid a tinted egg.



A FULL SISTER TO THE PULLET SHOWN ON THE PRECEDING PAGE

This hen resembles the Dorking in most of her characteristics but has only four toes on each foot. She was also used in pen 22 in 1913. (Fig. 7.)

She was presented to the Department by Mr. M. R. Jacobus of Ridgefield, N. J.

Another hen from the same source was also mated with this male but no eggs were secured from her.

In the following year, 1913, four of the females from the 1912 mating were mated with a White Leghorn cockerel. This bird was bred at the Beltsville Farm. He was low set and close feathered weighing 4½ pounds. He possessed a full breast, five-point comb, rich red eye and rich yellow legs set well apart. He was absolutely pure white in surface and under-color and carried a low, well spread tail. His ear lobes were white. At the same time it was thought desirable to make a new cross. Consequently, a Single Comb White Leghorn cockerel bred at the Beltsville farm was mated to four Silver Gray Dorking females. These females were purchased from Mr. Watson Westfall of Sayre, Pa. They were said to be three years old at the time of mating and averaged 6½ to seven pounds in weight. All laid tinted eggs. They were typical Dorkings in every respect, having rich red eyes, small ear lobes about one-half white, white legs and five toes on each foot.

In the years following 1913 the breeding operations consisted of constant selection as no new crosses were

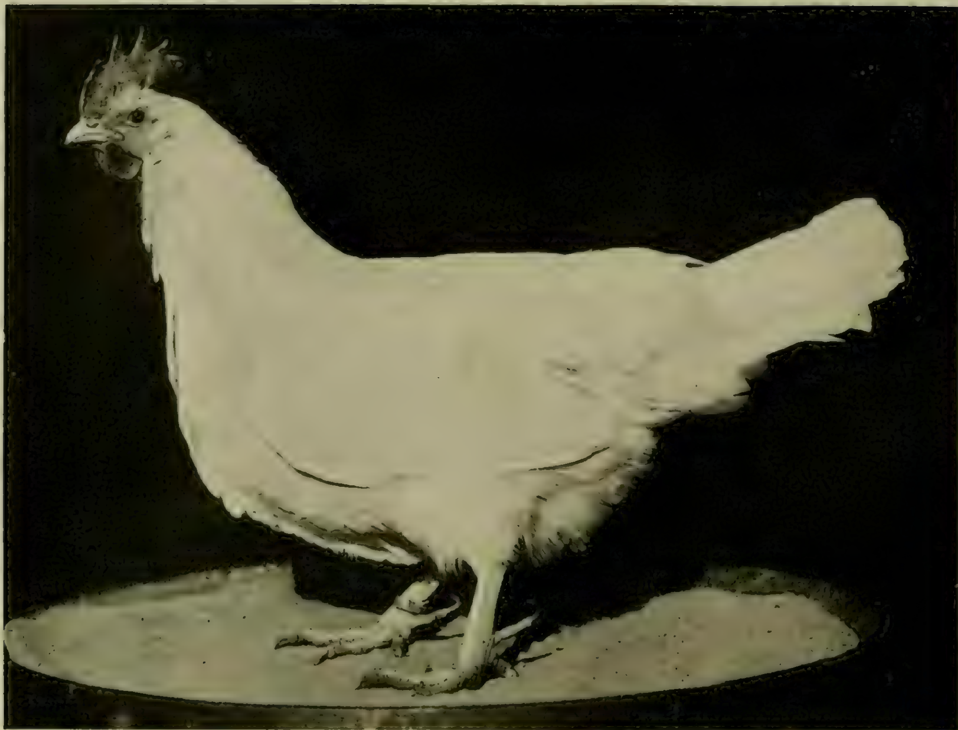
A CROSSBRED MALE

The hens shown in the three last preceding photographs, Figs. 5, 6 and 7, comprising pen No. 22, were mated to a Single Comb White Leghorn male in 1913 (see Fig. 3), giving a cross of White Plymouth Rock, plus Single Comb White Leghorn on the Dorking foundation. The bird shown in this picture is one of the offspring of that mating, and this male was bred to the pullets in pen 9 the following year (1914). There is a slight amount of red in the ear lobe. Note also the thick, low set body and the heavy bone. (Fig. 8.)

made nor was any other purebred individual of the three original varieties employed. The offspring from the various matings in the different years were selected and mated without respect to the proportion of blood which they carried, but simply on the grounds of how closely they approached to what was desired, or in some cases for the purpose of strengthening some special point.

OFFSPRING OF THE FIRST CROSS

From the first cross of the 1912 matings seven chicks were hatched and matured, all of them being females. Four of these had the markings of poorly bred Barred Plymouth Rocks and three were grayish barred except on the breast which was lighter and barred with buff and grayish black. Four of these birds had four toes on each foot.



A FIRST GENERATION PULLET FROM THE LEGHORN-DORKING CROSS (PEN 18)

Note the long breast bone characteristic of the Dorking, and also the fifth toe on each foot. The ear lobe is white. (Fig. 9.)

IDENTIFICATION OF PENS

Year	*Pen. No.*	*Mating*
1912	Original mating	White Plymouth Rock Male with Silver Gray Dorking Female
1913	22	S. C. White Leghorn Male with Females from 1912 mating. These females were ½ White Plymouth Rock and ½ Silver Gray Dorking.
	18	S. C. White Leghorn Male with Silver Gray Dorking Females
1914	9	Male out of Penn 22 which was ½ White Leghorn, ¼ White Plymouth Rock and ¼ Silver Gray Dorking, with Females out of Pen 18, which were ½ White Leghorn and ½ Silver Gray Dorking.
1914	7	Male out of Pen 22, which was ½ White Leghorn, ¼ White Plymouth Rock and ¼ Silver Gray Dorking, with Females out of Pen 18, which were ½ White Leghorn and ½ Silver Gray Dorking.
	17	Male out of Pen 22, which was ½ White Leghorn, ¼ White Plymouth Rock and ¼ Silver Gray Dorking, with Females out of Pen 22, which were ½ White Leghorn, ¼ White Plymouth Rock and ¼ Silver Gray Dorking.

In subsequent years all birds used in the matings were out of these matings shown or out of matings composed of their descendants without the use of any outside blood or purebred individuals.

A CROSSBRED MALE (NO. 633)

This bird was out of pen No. 22 of 1913, and was mated to the pullets in pen No. 7 in 1914. Compare with Fig. 8. Both birds are bred alike, i.e., Single Comb White Leghorn × (White Plymouth Rock × Silver Gray Dorking), and are what horsemen would call "full brothers in blood." The bird shown in this picture is somewhat coarser than the one shown in Fig. 8 and has no red in his ear lobe, but more nearly approaches the Dorking type. (Fig. 10.)

The others had five toes. All had white legs. Three of these birds did not mature into good specimens and were therefore not used in the breeding work the following year. The other four females were known as pen 22 in 1913 and were mated with a White Leghorn cockerel.

One of these pullets died shortly after the mating was made. Of the three remaining, one had very poor Barred Rock markings and color, was too loose in feathering and did not have the length of body which was desired. Her ear lobes were small and about one-half red. Her legs were white and she had five toes on each foot and weighed five pounds. The second had a surface color of grayish barring except the breast which was lighter and barred with buff and grayish black. She was about correct in length of leg but did not have the length of body desired. She was too loose in feathering and more on the Plymouth Rock than Dorking type. Her ear lobes were small and nearly white. She had five toes on each foot, white legs and weighed 4¾

THE FIRST APPEARANCE OF BUFF COLOR

A pullet from pen 18 of 1913—Leghorn×Dorking. Compare it with Fig. 9 and note the resemblance in conformation, but different comb, and no fifth toe. Note also the pigment in her breast the color of which was buff. This was the first appearance of that character. This hen was in breeding pen 7 in 1914. (See Fig. 10.) (Fig. 11.)

pounds. The third pullet was the same in general description as the preceding except that she had four toes on each foot and weighed only 3¾ pounds. Two of these pullets laid a brown egg and the other a light brown egg.

From this mating there were used in the breeding pens in 1914 three cockerels and seven pullets. All of the cockerels were white although one showed a few buff feathers and another a small amount of black ticking. In ear lobe one cockerel was white, one nearly white and one about half red. Two of the cockerels had five toes on each foot and the other had four. The legs of two cockerels were white and the other yellow. In weight the cockerels were as follows: 4.9, 5.3, and 5.4 pounds. In general these birds were lighter than was desired and tended to be too small all around and too high on legs. There was also a decided tendency for these birds to be too short in body. Of the seven pullets from this mating all were white with some black ticking and some black splashing and occasionally a little brassiness. In weight they ranged as follows: 3.7, 3.5, 3.8, 3.8, 4, 3.2, and 4 pounds.

Four pullets had white ear lobes, two nearly white and one nearly red. Four had yellowish white legs, one white legs and two yellow legs. Five pullets had four toes on each foot, one had four toes on one foot and five on the other, and one had five toes on each foot. In general these females were too short and too small all around but were quite good so far as length of leg was con-

A CROSSBRED PULLET

First generation pullets from pen 18 (Leghorn × Dorking. See Fig. 11) were mated to the male shown in Fig. 10 White Leghorn (Plymouth Rock-Dorking). This pen was designated No. 7 and the pullet shown in this picture is one of the offspring. There is a decided increase in size and weight. (Fig. 12.)

cerned. Four of the pullets laid brown eggs and three white eggs.

The other mating in 1913 consisted as stated before of four typical Silver Gray Dorking females and a Single Comb White Leghorn cockerel. From this mating there were used in the breeding pens the following year fourteen pullets. All of these pullets were white or nearly white except for a little ticking and some black splashing with an occasional showing of brassiness or salmon buff. All had nearly white ear lobes, white legs and all laid white eggs with one exception which laid a slightly tinted egg. Two had four toes on each foot, ten had five toes on each foot and two had four toes on one foot and five on the other. In weight they were as follows: 3.9, 3.9, 4, 3.9, 3.9, 4, 5, 3.4, 3.6, 3.5, 3.2, 3.9, 3.5, and 4.3 pounds.

GENERAL DESCRIPTION OF SUBSEQUENT OFFSPRING

As the breeding was carried on from year to year and subsequent matings made, there was a slight tendency for the comb to be rather large, similar to that of the Dorking. Of course, there was considerable variation in this and some neat combs were obtained. At the present time the combs are somewhat coarser on the average than those of Plymouth Rocks and in the females most of them are lopped. For the first few years the color of plumage, while

BLOCKY FORM AND RUGGEDNESS CHARACTERIZED BY MALES OF SIMILAR BREEDING

This male is from pen 22, and is the one which headed pen No. 17 in 1914. Note the pure white ear lobe. Compare with Figs. 8 and 10. (Fig. 13.)

white in the majority of cases, showed a considerable variation, ranging all the way from birds showing more or less black splashing or ticking to those which were pure black in color with the exception of a little white in wings. Other colors which commonly occurred were birds of poor Dominique markings and birds which showed with this marking an admixture of buff or red. Frequently also males were obtained which showed red on saddle, back and shoulders, and females which showed buff on breast, frequently extending to hackle and shoulders. In less frequent instances offspring were obtained showing more or less buff throughout the plumage. It might be noted here that some of these buff breasted females and red saddled males, which, it will be seen, is much like the marking of Red Pyle varieties, proved to be so attractive that a pen of this sort has now been carried for several years in an effort to fix this particular marking. Another marking frequently obtained was general body color approaching that of poor Brown Leghorn markings on the males or in some instances being largely on the Wheaten Game color on the females.

Perhaps in the case of these males the color might more properly be called Black Red Game markings as many of these fowls have markings which are in a measure similar to the markings of our Brown Leghorn males. Some of these males in

ONE OF THE RESULTS OF THE MATING OF PEN 17 IN 1914

Note the Dominique markings. It will be recalled that the Dominique was used in making the Plymouth Rock. The mixture of blood from other breeds has caused the barring of the latter to revert to the Dominique type. (Fig. 14.)

addition to having the Black Red markings, had many feathers throughout their plumage of a bluish gray color. I bred a few specimens of this colorage for two or three years and finally abandoned them as I could see no necessity of trying to perpetuate them as a variety. They bred true and could have been very easily bred up to approach our present day Brown Leghorns as the type was principally Leghorn although an occasional bird resembled the Game being tall on its legs.

The so called Pyle markings seen on some of the specimens is probably due to the White Leghorn blood as we get

ON ANY PRODUCE MARKET THIS HEN WOULD BE CLASSED AS A MONGREL

A pullet from pen 9, which was the mating in 1914 of pullets from pen 18 with a male from pen 22. See Figs. 8 and 9. Here again are Dominique markings. She is far from that, however, because her ancestry is known and her heredity admits combinations which will help in the solution of the present problem. (Fig. 15.)

an occasional bird having these markings from our purest flocks of the latter breed.

As the breeding progressed, less and less off colored birds were obtained until, as will be seen by the accompanying description for offspring of the past year, practically only white birds were obtained, with the exception of a few showing the buff markings and with an occasional bird showing some black splashing or ticking. The color of plumage therefore may be said at the present time to be quite well fixed. In color of ear lobe there has been a wide and troublesome variation. At first the preponderance of white lobes was marked and for several generations very few solid red lobes were obtained. It was necessary therefore in selecting the mating to use both males and females which had only partially red lobes, in many instances the red constituting no more than one-fourth the lobe. In spite of this, however, the number of solid red lobes obtained has increased until at the present time a considerable number show this character, although many partially white lobes in varying proportions of color still occur. It should be stated in this connection that it has been difficult to make accurate observations regarding the color of ear lobe. This is especially true of birds which were culled or which died before they were mature. In females particularly, the lobe may be pale or even appear white when with

COCKEREL OF 1915—A REPORT OF PROGRESS

The first appearance of red color on shoulders, back and saddle, a character which some have claimed will make this breed of chickens famous, regardless of their undoubted merit as food producers. It has great advertising value, and attracts immediate attention. (Fig. 16.)

maturity it will redden up to a marked degree.

During the early years of the breeding the occurrence of five toes was common. With succeeding generations, however, the proportion of five-toed birds gradually decreased although it was necessary at times to use birds with five toes in the breeding pens in order to get the benefit of some exceptionally good quality which they possessed such as body type or white color. As will be seen from the subjoined table the occurrence of five toes at the present time is decidedly infrequent and this character may be said to be quite thoroughly fixed.

As with the occurrence of the five toes, so with respect to white legs. These occurred frequently during the early part of the experiment. As the breeding progressed, however, the proportion of white legs became less and less until at the present time white legs are almost as scarce as the proverbial "hens' teeth." In this connection it should be stated that any attempt to make observations on the color of legs of the newly hatched chicks is inaccurate. Not infrequently baby chicks

ANOTHER COCKEREL OF 1915

Note the Dominique and Brown Leghorn markings and the white ear lobe. It would have been easily possible to establish a strain with the Brown Leghorn markings but these have been discarded and attention directed solely to the white, and the white with buff and red. The reader can now see how varieties of poultry breeds are established. There is not so great a difference between the size and conformation type of the birds now appearing. The most important difference, except for the ear lobes, is in color. (Fig. 17.)

whose legs show white will afterward prove to have yellow legs.

In body type there has been, as might be expected, a wide variation. Even at the present time the type cannot be said to be very uniform but constant selection for the type desired has resulted in the elimination to a large extent of the lighter bodied birds which are set high on legs. In general the body type now obtained consists of a long body but not always one carried in a horizontal position.

The color of eggs laid by the hens probably has proved to be the most difficult character to fix. As soon as the offspring of the original crosses began to break up in the matter of egg color it proved to be rather difficult to secure good specimens for breeding which combined the red color of ear lobe and which laid or whose mothers laid white eggs. The only thing that could be done under these circumstances was to select, insofar as possible, the birds laying eggs nearest to

PROGRESS IS EVIDENT WITH EACH SUCCEEDING GENERATION

Here is a male hatched in 1916. Note the prominent breast bone and large body of this bird, the absence of the fifth toe, and the white ear lobe. (Fig. 18.)

white. Progress in this respect has necessarily been slow. This character is at present far from fixed, but the fact that quite numerous individuals have been obtained possessing red lobes and laying white eggs encourages the belief that the fixation of this combination of characters is merely a matter of continued breeding and infinite pains in selection.

In making observations in order to secure a description of birds in the various years no effort has been made to get a description of any which died at an early age except insofar as the number of toes was concerned. This practice has been followed because of the difficulty previously indicated of securing dependable descriptions of the ear lobe, color of immature birds and of the leg color of baby chicks. In addition it has been found that the plumage color of birds at an early stage is not a reliable index of their color when they mature. Quite a large proportion of the birds which later show buff breasts or red on the back and shoulders are pure white as younger birds.

SUMMARY OF RESULTS

A brief sketch of the color of the plumage, number of toes, leg color

ANOTHER PECULIAR KINK OF THE HEREDITARY MECHANISM

This pullet of 1916 is straw colored, which is on the order of the Wheaten Game color. (Fig. 19.)

(which also means the color of the skin), and the color of the ear lobes of the specimens for 1912, the year that the experiment was started, and each succeeding year, may be of interest. This information for 1912, having been mentioned in the early part of the article, I will take up in a brief way the statistics beginning with 1913. It should be remembered, however, that we had no specimens in 1912 that were white in plumage. It will be noticed that the same number of specimens were not observed for the different characters; only a sufficient number were used to get good averages.

As the chicks are taken from the incubators they are observed for number of toes only. Later, observations are made for color of legs, ear lobes and plumage, as it is impossible to tell definitely the color of the later characters until the chicks are several weeks old.

The greatest loss from raising chickens occurs during the first three weeks of their lives. These losses vary and are often very large. Many were also marketed. Hence the difference in the number of birds observed, at time of hatching, for number of toes, as compared with those observed, several weeks later, for the other characters. Then again in making our records one of the characters is sometimes overlooked.

1913. *Plumage color:* 3 white; 28 other colors.

Number of toes: Of 107 chicks observed for their number of toes, 50 had 4 toes on each foot and of the balance,

ANOTHER PULLET OF 1916, BRED PRACTICALLY THE SAME AS THE ONE SHOWN IN FIG. 19

There is considerable resemblance in type but none in color. This pullet is one of the most desirable individuals which have been produced in the experiment. In body shape, size and color, she is close to the ideal type. Her ear lobe is red. (Fig. 20.)

42 had 5 toes on each foot; 13 had 4 on one foot and 5 on the other; 1 had 5 on one foot and 6 on the other; 1 had 6 toes on each foot.

Leg color: 20 came white, showing the strength of the Dorking blood in this respect; 2 yellow; 4 white with a yellowish cast; 1 yellow with a whitish cast; 27 in all.

Lobe color: 19 white; 3 nearly white; 1 one-half red and one-half white; 1 nearly red; 24 in all. It will be noted that in this year, 1913, there was one specimen having a nearly red ear lobe.

1914. *Plumage color:* 68 white; 95 other colors.

Number of toes: Of 188 chicks observed, 137 had 4 toes on each foot; 39 had 5 toes on each foot; 12 had 4 toes on one foot and 5 on the other.

Leg color: 69 yellow; 81 white; the balance having yellowish and yellowish white, some greenish yellow, some blackish yellow, some white with a few black spots, one or two willow and two black, out of a total of 103 birds observed.

Lobe color: 7 red; the remainder of

A MALE OF 1917

Note the red ear lobe. At the time, this bird was the most typical yet produced. (Fig. 21.)

163 birds observed running all the way from white to red.

1915. *Plumage color:* 25 white, 64 other colors.

Number of toes: Of 395 birds observed, 308 had 4 toes on each foot; 68 had 5 on each foot; 14 had 4 on one foot and 5 on the other; 5 had 5 on one foot and 6 on the other.

Leg color: 42 yellow; 39 white. (It will be noticed that this year, 1915, was the first that we got more yellow-skinned chicks than those having white skins); the balance of 90 birds observed running all the way between white and yellow.

Lobe color: 15 red; 19 nearly red; 23 one-half red; 16 white; the balance being white and red of the 90 birds observed.

1916. *Plumage color:* 46 white; 123 other colors.

Number of toes: 286 had 4 toes on each foot; 39 had 5 toes on each foot; 12 had 4 on one foot and 5 on the other.

Leg color: 97 yellow; 64 white; and the balance of 170 birds observed running between those two shades.

A PULLET OF 1917

The tinting of the breast is buff, and that color is found in the hens of this strain of which the males have red backs (See Fig. 16). Note the body of this hen, and the four toes. Note also the white ear lobe. (Fig. 22.)

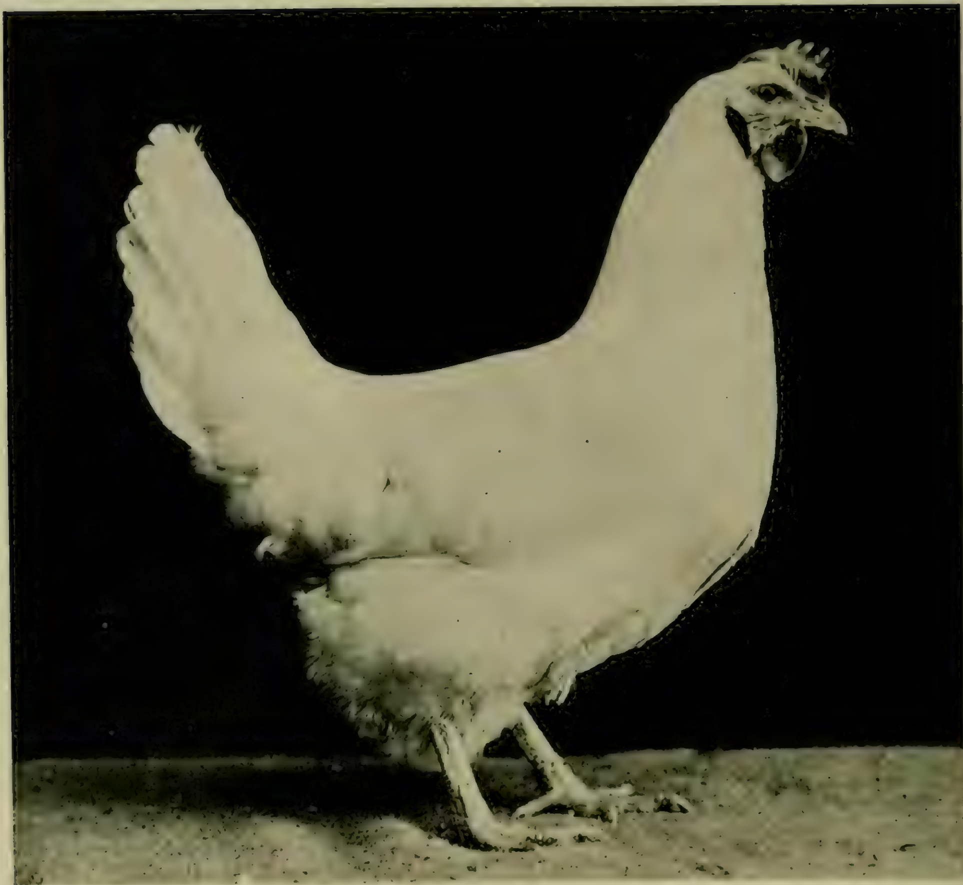
Lobe color: 47 red; 39 nearly red; 10 white. Of 160 birds observed 47 this year, 1916, had solid red ear lobes. I wish also to mention that the year 1916 gave the first specimens (2 in number) having solid red ear lobes that laid white-shelled eggs.

1917. The year 1917 showed that splendid progress was being made in the right direction.

Plumage color: 208 chicks came white; 311 other colors; out of a total of 519.

Number of toes: 712 had 4 toes on each foot; 68 had 5 on each foot; 1 had 6 on each foot; 20 had 4 on one foot and 5 on the other; 4 had 5 on one foot and 6 on the other; out of a total of 805 which were observed for this character. These figures show most conclusively that we were well away from the five-toed characteristic of the Dorking.

Leg color: Out of 520 observed 392 came yellow. As will readily be seen we were having very little trouble in getting specimens having yellow legs.



APPROACHING THE TYPE DESIRED

The preceding pictures show the material which the breeder has used, step by step. The combinations often have curious results, many of them disappointing, but each served its purpose. When the breed structure begins to assume shape, the anxieties of the past can be forgotten in the contemplation that the present is bringing forth the hoped for results. The pullet shown in this picture was hatched in 1918. She has a red ear lobe. (Fig. 23.)

Lobe color: This year 140 came with red ear lobes out of 520 observed and we had 15 females having red ear lobes that laid white-shelled eggs.

1918. *Plumage color:* 296 out of 479 specimens observed came with white plumage.

Number of toes: 470 out of 516 came with 4 toes on each foot.

Leg color: 445 out of 500 had yellow leg color.

Lobe color: 119 out of 479 observed had red ear lobes. Of the females having red ear lobes we secured but 3 that laid white-shelled eggs. I am unable to account for this seeming reversion to the tinted color of the eggs laid by the females of this year's breeding, except that the white shell color had not become well enough fixed to remain constant.

1919. *Plumage color:* 390 out of 436 came white.

Number of toes: Of 437 chicks observed 428 had 4 toes on each foot and 9 had 5 toes on each foot.

Leg color: Of 435 chicks 397 had yellow leg color.

WEIRD RESULTS IN COLOR AND CONFORMATION ARE NOW LESS FREQUENT

A male with red ear lobe, hatched in 1918. The breeder does not have to mate animals which are too far removed from his ideal type. Therefore he is obtaining a larger proportion of satisfactory offspring—making more hits and fewer misses. (Fig. 24.)

Lobe color: 150 out of 433 came with red ear lobes and of those females having red ear lobes we secured 13 that laid white-shelled eggs.

1920. This year showed a notable increase in the females having red ear lobes that laid white-shelled eggs, there being 45 in all.

Out of 684 cross-bred chicks hatched in 1920 on which observations were taken as to the number of toes, 664 had four toes, 16 had five toes, two had four toes on one foot and five on the other foot, and two had five toes on one foot and six on the other.

Out of 464 cross-bred chicks hatched in 1920, 155 had red lobes, 64 had nearly red lobes, 64 had three-fourths red lobes, 80 had one-half red lobes, 28 had one-quarter red lobes, 51 had nearly white lobes and 23 had white lobes.

MALE OF 1919 WITH RED EAR LOBE

A good deal remains to be done in refining certain points, but type is fixed fairly well. (Fig. 25.)

Out of 472 cross-bred chicks hatched in 1920, 470 had yellow legs and beak, and two had white legs and beak.

Out of 434 cross-bred chicks hatched in 1920 from the white matings, 401 had white plumage although a few males showed some brass on back, 30 had Red Pyle markings varying from very heavy with buff running into other sections to very light only showing a touch of buff on head or a touch of buff or red on shoulders of males, three white with black splashing or ticking or both.

Out of 35 cross-bred chicks hatched in 1920 from the buff breasted matings 24 showed Red Pyle marking in some degree, one poor Dominique markings, one poor Brown Leghorn markings, three poor or light Dominique markings with splashing of buff or white, four white splashed with gray, buff, red or black, or a combination of these colors, one white with a little buff in surface, one brownish black stippled and shafted with buff, buff lacing on hackle, and white lacing or spangling and salmon on breast.

ONE OF THE MOST TYPICAL YET PRODUCED

A pullet of 1919. Her ear lobe contains both red and white. As stated in the beginning, it was desired to secure characters of weight, flesh, yellow legs, single comb, white color, four-toed feet, and a red ear lobe, and to eliminate the character of brown shelled eggs. With further attention to some minor points, it is believed the desired type has become fixed. Compare this hen with the one shown in the frontispiece. The two illustrations represent the type developed as the Lamona breed of poultry. (Fig. 26.)

The 208 pullets hatched in 1920 averaged 4.28 pounds, all weights being taken during the month of November. Thirty-five cockerels weighed on the average of 6.25 pounds.

The following are the weights of cross-bred cocks of different ages taken about January 1, 1921:

Three birds hatched in 1918 weighed 6.1, 6.5 and 7.4 pounds respectively.

Two birds hatched in 1919 weighed 6.9 and 7.4 pounds respectively.

Two birds whose date of hatch is unknown (they having lost their leg bands) weighed 5.8 and 8.1 pounds respectively.

The following are the average weights of cross-bred hens of different ages taken about January 1, 1921:

1 hen,	hatched	1916,	weighed	6.3 lbs.
5 hens,	hatched	1917,	averaged	5.6 lbs.
16	"	1918,	"	5.38 "
33	"	1919,	"	5.87 "

The weights of buff hens were as follows:

4 hens,	hatched	1916,	averaged	4.95 lbs.
4	"	1917,	"	5.37 "
3	"	1918,	"	5.5 "

BETTER AMERICAN FAMILIES—V

Some Leaders of American Thought, Offshoots of Superior Families, Who Helped to Form American Ideals and Shape Its Political and Social History

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AMERICA still awaits the poet who shall write her supreme epic. The story of the conquest of a continent through sacrifice and hardihood is not the only one that our history records. Rather it should be the story of the march of new and vital ideas, conceived by the chosen few, but now the possession of the many. For materialistic America, swinging alternately between rule of money-king and grasping money-loving masses is yet incurably idealistic. This idealism had its share in the winning of the world war, in the spiritual re-enforcement which the American troops, pugnacious, profane and coarse-fibred as many of them no doubt were, brought to the winning of the great cause.

This idealism is largely the inheritance from the early settlers on Massachusetts Bay. These settlers, drawn from some of the most virile stocks of old England, gave to the experiment in democracy not only physical virility but a set of virile ideas. Puritanism is not so much a religious dogma as a continuing social force. It took only a century for a new race to be born here. This was a race formed by a new and adverse environment and molded by countless novel experiences, but more than all vitalized by one or two great ideas, caught from great leaders in our social, religious and political life.

EARLY AMERICAN LEADERS

Turning now to this, the more purely idealistic field of American development, let us review briefly some types of leadership as exemplified in such families as the Beecher, Abbott, Edwards, Adams, Lowell and Lawrence Families. These men carried the courage and resourcefulness of the pioneer into the realms of politics, religion and education, predestined, we might say, to leadership by virtue of birth and the social heritage which was theirs. The regnant personalities here described are the offshoots of superior stocks, gifted far above the average in insight, altruism and love of truth. They have found their followers in hundreds of lesser individuals belonging to less distinguished families, whose adherence was nevertheless of equal importance with their own part in the realization of their aims. It is this infiltration of ideas into families and races, whether better or worse than the average, who however catch the spirit and feel themselves to be superior and act accordingly, that constitutes the essence of Americanism.

THE ADAMS FAMILY

In the field of statecraft, no family stands out more conspicuously for its services than does the Adams family. Just because it is so well known, it will not need to be considered at great length. It is the only American family that furnishes two names to the list of the first thousand who are distinguished in human history. John Adams, second president of the United States is counted among the first five hundred, and John Quincy Adams, his son, is included in the second five hundred. The earliest representative of the family to enter public life was Samuel Adams, the "Father of the American Revolution." He had the well-known Adams characteristics. "Such is the obstinacy and inflexible disposition of the man, that he can never be conciliated by any office or gift whatsoever." . . . . "I should advise persisting in our struggle for liberty, though it were revealed from heaven that nine hundred and ninety nine were

to perish, and only one of a thousand were to survive and retain his liberty." Thus spoke the temper of the man who originated the Colonial Congress, and was the earliest advocate of a Continental Congress. He signed the Declaration of Independence was a leading member of the convention to form a State Constitution and served his State as governor. John Adams, his cousin, had the same determination and far-sighted vision of the possibilities of young America. Dour, aloof and irritable to a degree, he served his country in more public offices than any other patriot of his time, bringing upon himself a greater odium and ingratitude than fell to the share of any man of his time, with the possible exception of Washington. His wife was Abigail Smith of many gifts, including a quick wit and sprightly pen. All of their children were unusually able, John Quincy having many characteristics in common with his mother's family. He too, had the sterling, unconciliatory qualities which made him often the most unpopular spokesman for a cause and kept him in the harness of the most exacting public duties to the very day of his death. To him we owe primarily our Monroe Doctrine, and the idea that slavery could be abolished through the war power of the government.

In the following generation we have among others, Charles Francis Adams, who through his peculiar personal characteristics—aloofness, sturdiness and simplicity—rendered unparalleled service to the Union cause at his diplomatic post in London during the Civil War. This family has in the branch just considered, as well as others, many members eminent in art, finance and education. Who shall estimate the value of the gifts which it has brought to strengthen and enrich our national life?

THE BEECHERS AND CONNECTED FAMILIES

Taking up now a family of quite different temper, which has produced two members of Hall of Fame grade, we have the Beecher network, including members of the Lyman, Ward and Foote families, in which intellectual and musical ability, changing moods, affection and breadth of sympathy are outstanding characteristics. Henry Ward Beecher was eminent for philosophic insight, spiritual vision and powers of persuasion, while his fairness and self-control made him render unqualified service during the difficult periods of the Civil War and Reconstruction. Through his genius for friendship, gift of oratory and writing he wielded a vast power for righteousness unparalleled in his day. His sister, Harriet Beecher Stowe, whose "Uncle Tom's Cabin" perhaps did more to mold public opinion toward the abolition of slavery, had a literary gift which was essentially dramatic, with an overpowering love for the heroic. These two belonged to a large family, all of whom were able. The best known of that family was probably Catherine Beecher, who worked for the education of women and showed the originality and versatility of her mind in writings covering a wide range of domestic, religious and philosophic subjects. Five of the brothers were preachers and active in the reforms of their day. Their father, Lyman Beecher, overflowed with sympathy and high spirits, wrote extensively, and was tried for heresy, while their mother, Roxanna Foote, was scholarly with a profound philosophical and affectionate nature, a lover of the beautiful in nature and art, although of so great diffidence that she was unable to lead the weekly prayer-meeting. David Beecher, one of the grandparents, had the varied practical ability of the blacksmith along with a fondness for reading and discussion. He had a Pomeroy for a grandmother. He married Esther Lyman, a woman of joyous, sparkling temperament. Eli Foote, the maternal grandfather, was of elegant person and cultivated taste, who was educated for the bar and later became a merchant. This family shows a remarkable flowering out in a single generation, which is plainly the result of the coming together of strains widely

varied, though all bearing considerable gifts.

DESCENDANTS OF SAMUEL LAWRENCE

As an illustration of wide divergence in lines, we may take the history of the descendants of Major Samuel Lawrence. He had five sons, all of whom displayed ability above the average, one a lawyer and four who followed manufacturing, giving their name to the cities of Lawrence in the states of Massachusetts and Kansas, besides Lawrence University and Lawrence Scientific School. Of the five, two founded lines which show great longevity and illustrate strikingly the necessity of long life for eugenic fitness. It is among the descendents of Amos and Abbott Lawrence that the greatest number of distinguished names appears. Amos married Sara Richards, whose father had superior ability largely of a mechanical nature, and whose mother was a daughter of Amos Adams. One of their sons became a physician and director of many municipal undertakings, while Amos Adams Lawrence was known for his success in promoting the cause of the Free Soil Party. Abbott Lawrence, besides conducting manufactures on a gigantic scale, rendered his country signal service as a diplomat in many trying situations. In this he takes rank with Franklin. His success was due to his quick perception of the merits of a question, infinite tact and thoroughgoing truthfulness. He married Katharine Bigelow, daughter of Timothy Bigelow and Lucy Prescott. Timothy Bigelow was a distinguished speaker in the Massachusetts legislature. Two of their sons were merchants noted for public spirit, a third, consul-general to Italy, while a daughter, Anna, counts among her descendants eminent physicians and architects. The younger daughter, Katharine, through her marriage to Augustus Lowell, became the mother of Percival Lowell, director of an astronomical observatory, Elizabeth Lowell (Mrs. William Lowell Putnam), writer and active in welfare work, Abbott Lawrence Lowell, President of Harvard University, and Amy Lowell, writer of free verse. Thus the gifts of this family, through marriages into equally gifted stocks have given character during two centuries to local and national life in science, art, politics and a wide range of philanthropies.

OTHER CONSPICUOUS EXAMPLES

The Dwight-Edwards-Woolsey network has often been cited for its conspicuous examples of scholarship, brilliant exposition and signal administrative ability. As this family has ramified into many of the great families of New England, producing hundreds of eminent men and women, so the families of Lee, Fitz-Hugh and Randolph of Virginia, and Preston, Breckenridge, Payne and Porter of Kentucky have ramified into other "better families" to furnish names of outstanding merit in the direction of our history.

THEODORE ROOSEVELT'S ANTECEDENTS

Of the volumes that have been written to establish the claim of Theodore Roosevelt to a place among the three greatest Americans, and as "the greatest American of his day," little has been said of his birthright to this title. He is known to have claimed derivation from five or six strains all of which were noted for their fighting qualities; and it is probably not generally known that his forebears included at least two who might be taken as prototypes of himself. These were Archibald Bulloch, great-grandfather, and Robert Barnwell Roosevelt. Archibald Bulloch was governor of Georgia during the Revolution. He took an active part in the patriot cause when its friends were few and was a member of the Continental Congress. When a sentinel was posted at the door of the Executive office, he ordered him removed, saying: "I act for a free people, in whom I have entire confidence, and wish to avoid on all occasions, the appearance of ostentation"—words which may well be taken as the text of the life of his distinguished grandson.

Robert Barnwell Roosevelt showed wide versatility, making his mark in many fields including politics, literature and sports. He was a popular contributor to magazine literature, where he showed vivid imagination and genial humor, practiced law for twenty years and most of this time was actively engaged in politics; he was editor of the *New York Citizen*, a reform organ, and was in the front rank in the fight with the "Tweed Ring." Elected to Congress, his course was independent and above the demands of his party's leaders. He was an enthusiastic sportsman and organized clubs for the preservation of game, besides founding the New York Fish Commission which he served as commissioner for twenty years without pay. "He inherited and exemplified the rugged virtues, sterling honesty, indomitable courage and persistent patience, together with the sincere kindliness of his Dutch ancestors. . . . His outspoken independence and fearless honesty combined with his high ideals of citizenship did not qualify him to be a successful politician. He was content to be a statesman." It will readily be seen that these were traits which made for leadership in his nephew. Roosevelt's father, though primarily an importer and banker, was active in many reforms of his day. He was a patron of the arts, a lover of the woods, shared in every athletic sport, "a man of untiring energy, of prodigious industry, the most valiant fighter of the day for the right, and the winner of his fights." Roosevelt's mother, though gracious and retiring, entirely lacking in the combativeness characteristic of her son, united in herself several strains known for courage in their devotion to the public weal. She was a fine horsewoman and absolutely fearless. Cornelius Roosevelt, the paternal grandfather, made a fortune as a banker, devoting the latter portion of his life to charity, while his wife, from a Pennsylvania family not so well known, numbered among her relatives many who had the courage and rugged independence that characterized the grandson who became the most representative American of the age.

With such a concentration of gifts from both sides of his family, it seems almost inevitable that his course should have been what it was. Still the part played by peculiar conditions—industrial, social and political—in bringing out Roosevelt's salient abilities is not inconsiderable. Furthermore, the characteristic intellectual and moral reactions of his family, were in him associated with an unusual physiologic condition, which made it possible and even necessary, that every undertaking be followed out with great intensity. His father had this in considerable measure, as did his uncle Robert. Added to this is the fact that Roosevelt's strongest tendencies were in close accord with certain dynamic forces in American life. He entered public life just when the nation was entering into a significant period of development. Re-united after the Civil War, the country's unexampled industrial growth was rapidly giving it world-leadership in industry with an importance in international relationships hitherto undreamed of. Big business was dictating state, national and international policies and the American conscience was becoming restive under the distortion of ideals which this dictatorship too often entailed. It was natural that a forthright, courageous nature, loving conflict and loving the rights of the common people more, should find here a fertile field for the development of its highest powers. The appeal which he made to the conscience of the American people was inevitable as was the reciprocal effect of the sense of his national responsibility on his initial tendencies.

In his battle with the trusts, to take one example, he sensed their unscrupulous and irresponsible activities as directly in opposition to the fundamental tendencies of the American people. The trust had organization, wealth and prestige in its favor, tremendous odds, but through his understanding of the people, Roosevelt was able to rally their strong though inchoate strivings

toward right and justice into a system of opposition and lead them to at least a partial victory. Thus by his restless, irresistible energy and sympathy with the fundamental tendencies of the people, he became the finest example of the creative influence of a personality in our national life.

REGNANT FAMILIES OF THE PRESENT DAY

This is the supreme achievement in the great epic of American development. It is the epic of armies battling ceaselessly to conquer adverse forces of nature, and working unremittingly for the realization of ideals, which have first been conceived, or at least phrased by a few great personalities, then incorporated in the institutions founded by them and fructified by their spirit.

When the history of the immigrant stocks of the nineteenth century is written, it will present a picture quite as striking for its share in the realization of the American ideal as the earlier strivings of the liberty-loving, right-abiding migrant to our shores. The bone and sinew of our nation today is largely made up of comparatively new stocks. Names such as Frick, Carnegie, Johnson, Kahn, Walsh, Leiter, Lewisohn, have an increasing representation among our capitalists, political leaders, patrons of science and the arts.

We need not greatly worry over the possibility of the "Fall of the American Saxon" nor of the decadence of certain colonial stocks. Much of their best blood has fused with the best of the incoming strains, so that their aptitudes and gifts can never be lost. Added to this, under the rigorous conditions of frontier life, it frequently happened that the best representatives of average stocks came together and founded lines having superior endowment. A like process to that observed in the Claiborne family has undoubtedly repeated itself many times if in lesser degree under the urge of personal ambition or motives more altruistic.

"The family was for six hundred years more or less prominent in the warring, intriguing life of the Scottish border. In the early part of the seventeenth century it was represented by three sons. The eldest was Thomas, indolent, shy, melancholy, who succeeded to the family estates, where he lived a retired life, taking no active part in affairs of state. His line became obscure tillers of the soil where a few generations before their fathers had ruled as lords. The youngest son was Robert, whose ambitions did not rise above the station of a London clothes-dealer, and whose descendants, if he had any, have become completely lost to the rest of the family.

William Claiborne, the second son, came to Jamestown in 1621 as Royal Surveyor and became successively Captain, Colonel, Secretary and eventually Parliamentary Secretary of Virginia. He is described as a man of powerful, magnetic personality. Resourceful, tenacious and indomitable in his large designs, he perhaps more than any other single man shaped the history of the colony through a half-century of stormy contention with her rival sister colony of Maryland.

His children and grandchildren married into some of the best Virginia families and their descendants number many men of mark. Among the 998 persons enumerated in the Claiborne genealogy, we find 22 who were army officers, 19 who served their country in a legislative or administrative capacity and 7 who were justices or judges. The list is as noteworthy for the absence of gifts, artistic and scientific as it is for the presence of those which make for military and political leadership. We must conclude that the daring, persevering qualities which carried their possessors to success in new and difficult ventures at the same time made possible frequent alliances with families having high similar potentialities and this selective mating produced an unusual number conforming to the original type.

CONTRIBUTIONS FROM FORMER GENERATIONS

Today, America's policies as conceived and elaborated by such leaders

as we have described, are receiving the attention of the civilized world. America's great contributions to political thought, her adoption of a Constitution under which peoples of wide genetic derivation and worth can prosper according to individual merit, her liberal policy toward her territorial possessions, and her Monroe Doctrine are all chiefly due to the families here considered. It is of no slight significance, when under the flexible social conditions of our day, Nancy Langhorne, an offshoot of "the first families of Virginia" marries a scion of a more recent commercial family, whose fortune was founded on careful thrift and calculation, and through the social prestige which her wealth and her native wit give her, becomes, as Lady Astor, the first woman representative in Britain's legislative halls.

It is well for the nations that all unconsciously there have been these processes at work to create the robust energies of mind and heart necessary to this great work; but far better for her ultimate destiny and theirs if we infuse into the education of our people some conception of the fundamental relation of inherent human traits and our social and political structure. Such a conception cannot but lead to sound eugenic ideals and a reasonable conformity in practice.

THE PRESERVATION OF ABILITIES

Few families keep a level of ability. From generation to generation, they rise and fall according to the type of marriages made. Sometimes even a few generations suffice to make so wide a divergence between two lines that all idea of relationship is lost. The study of any comprehensive genealogy brings into relief lines standing for ability in business, mechanical construction, art, science or statecraft. Similarly one may, with a little study, trace in his own family changes in aptitude through the criss-cross of marriages in successive generations. Thus every marriage becomes a matter of serious concern to the future of the family and the future of the nation of which the family is a constituent part.

The world war, it appears, has but ushered in a longer, intenser struggle for supremacy in which every means for increasing human efficiency will be taxed to the utmost. In the face of this necessity a more rigid policy of state care of the socially inadequate and control of marriages must play its indispensable part. But more than this, far more important is it that we foster an enlightened sense of responsibility in marriage, to the state and to humanity. This is the responsibility of maintaining through selective marriages the highest possible level of ability in the family. Thus shall it be given to those who are "good Americans" to preserve lines of better American families and perform an unexampled service in national and racial growth.

Cannon's Book Reprinted

Bodily Changes in Pain, Hunger, Fear and Rage, by Walter B. Cannon, M.D., C.B., George Higginson professor of physiology in Harvard University. Pp. 311, price $3. New York and London, D. Appleton & Co., 1920.

Dr. Cannon's admirable volume on the physiological bases of the emotions reappears with a new date line, but apparently without any other change. In the five years since it was first issued his data have become an integral part of current science. Indeed, the changes that occur in the body with the existence of intense emotion are almost a matter of common knowledge. This book will be almost indispensable reading to all biologists who have not read it; while the last chapter makes a contribution to eugenics by discussing the possibility of substituting athletics or other active forms of competition for destructive warfare.—P. P.

A TYPICAL HEREFORD BULL

A typical Hereford is characterized by medium to deep, rich red color of body, with white face, crest, brisket and switch, with white predominating below the knees and hocks. This animal, Bonnie J., 595,351, owned by E. E. Mack & Sons, is an excellent representative of the best in its breed. Desirable beef conformation is shown by its low, compact, blocky body, well sprung ribs, broad, deep loin and well developed hind quarters. Photograph (by Hildebrand) supplied through Bureau of Animal Industry, U. S. Dept. of Agriculture. (Fig. 27.)

GENETICS OF HEREFORD CATTLE

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FEW attempts have been made as yet to apply to the larger and more valuable domestic animals the principles of genetics worked out in the case of laboratory animals and plants which can be reared in large numbers at relatively small expense. Direct experiment with horses or cattle for the demonstration of genetic principles has rarely been undertaken, but some incidental observations have been recorded in regard to breeding operations with such animals conducted primarily for economic reasons. A valuable set of observations of this latter type made upon a large herd of pedigreed Hereford cattle has recently been published.[1] It is a first contribution toward a genetic analysis of the distinctive color pattern of this breed.

The "typical Hereford" is described as "a deep red beast, with white face and underparts, white feet, white at the end of the tail, and with a white patch along the top of the neck. Sometimes there is a trace of red round the eyes. The stranger to the breed is generally impressed by the constancy of these markings; still variations from the type do occur. It is hardly necessary to add that the Hereford is a very heavy fleshed beast, fattening rapidly, and is the premier beef breed of the world, having spread to every country where beef raising is a considerable industry." See Fig. 27.

"Minor points that breeders attend to are: coat color, which should be a rich purple red, not a yellow-brown; a clean, clear nose, without spots or markings; and the horns, which should be free from pigment at the tips."

The salient points in the foregoing description relate to the quality and distribution of pigment in the coat. As regards quality, the desired shade is an intense red (never black) distributed throughout the coat except where white is found. White occurs in a fundamental pattern seen in many breeds of European cattle. Ramm[2] depicts some seven different breeds of cattle from different parts of continental Europe which show this same fundamental pattern, in which white occurs on the head and extends thence ventrally along the "underline" to the tail, and dorsally as a spinal white stripe to the shoulders or even to the rump, thus nearly (in extreme cases quite) encircling the animal in the median plane. Cattle of this general pattern kept in Herefordshire, England, in the 17th century formed the foundation stock from which the modern Hereford breed apparently was evolved. The genetic analysis of the breed, made in the paper under review, indicates that specific Mendelian modifying factors have in the past two centuries and a half been incorporated in the breed, having perhaps originated by a series of minor mutations, which systematic selection has seized hold of and retained as distinctive features of the modern breed. The author identifies five unit-character variations which may be regarded as having been added to the genetic complex found in the ancestral Herefords and in various other breeds of cattle possessing the same pattern of median plane white on a colored background. The five hypothetical Hereford factors are:

1. A *whitening* factor, W, which modifies what would otherwise be a typical Hereford (grade 0, Fig. 28) to one having an "excess of white," as illustrated in grade −1 to −4, Fig. 28.

2. A *darkening* factor, D, having an effect contrary to that of the whitening factor. It changes what would otherwise be a typical Hereford (grade 0) to one of grade +2 or +3, Fig. 28. The greatest change is noted in the neck region, hence the factor is called the "dark neck" factor, although its effects are not restricted to that region of the body.

[1] Frances Pitt. Notes on the inheritance of color and markings in pedigreed Hereford cattle. Journal of Genetics, 9, Feb. 1920.

[2] Ramm, E., 1901. Die Arten und Rassen des Rindes. Stuttgart.

3. The third hypothetical factor is suggested to account for the frequent occurrence of an isolated spot of color around the eye, a region commonly pigmented in white spotted mammals in general.

4. Pigmented or "dirty" nose is supposed to be due to a fourth factor. It is regarded as a blemish, arising from the undesired presence of black or brown pigment in the skin of the nose, which should be unpigmented.

5. The fifth hypothetical factor relates to the general color of the coat, which should by present breed standards be dark red, of a "deep plum tint called *claret* or *purple*." But many individuals of the breed are of a lighter shade known as "yellow," which appears to be dominant over the desired dark shade.

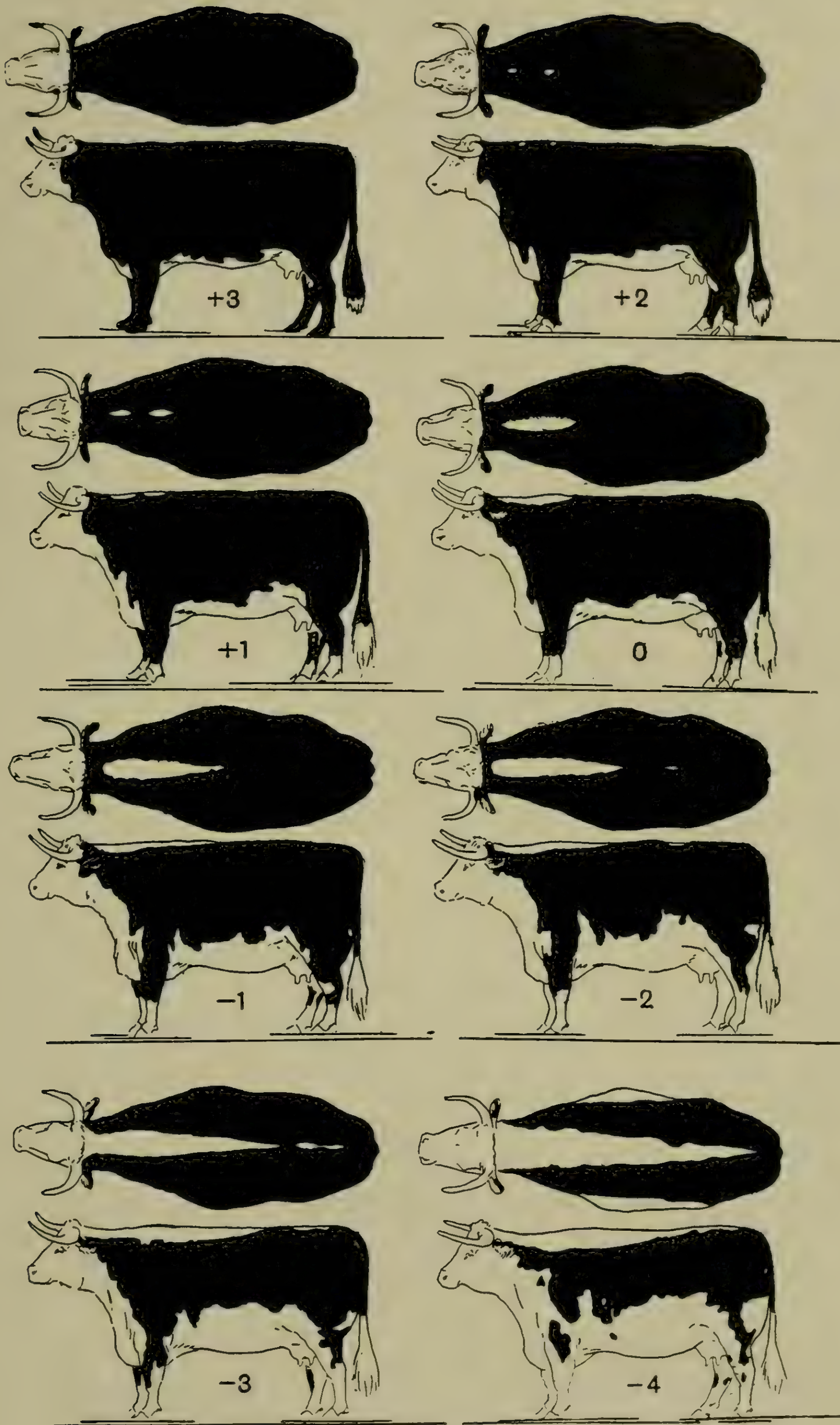
This five-factor scheme of modifying factors forms an excellent working hypothesis for studying the problem outlined, but it has not been utilized as fully as the available records apparently warrant. For the records, we are told, consist of photographs of each calf born in the herd, which may be compared with the patterns of dam, sire, and other relatives, a very excellent system. A system of grading each animal accurately as regards extent of pigmentation was also worked out, which is copied in Fig. 28. But in describing the observed results no use is made of this grading scheme. We are told the results of particular matings, not in terms of the grades of sire, dam, and offspring, but only in terms of the assumed factors. If an analysis has actually been made of the pedigrees published, in terms of grades as well as in terms of assumed factors, that analysis should be given to the reader, that he may judge for himself whether the hypothetical scheme fits the facts well or ill.

Of the five assumed Hereford factors, three are supposed to be dominant and two recessive. The whitening factor is regarded as recessive, the darkening factor as dominant. Why, it might be asked, may the analysis not be simplified by treating "dark" and "white" as dominant and recessive members respectively of a single set of allelomorphs? Does either one breed true? That is really the crucial point which the published records do not cover. In work with other spotted mammals, no grade of white spotting has been found to breed true. And so it seems very doubtful that any particular grade of Hereford cattle will be found to breed true. Indeed the author assumes that "the factor for excessive white is variable in its somatic expression" and in particular that it acts as a partial inhibitor or neutralizer of dark. Accordingly it seems very doubtful whether two modifying factors acting in opposite directions are sufficient to account for such graded variation as other white spotted mammals manifest, and such as the grading scale of Fig. 28 indicates to occur among Hereford cattle, unless we assume that the factors themselves fluctuate, an hypothesis commonly regarded as untenable, for good and sufficient reasons.

The scheme outlined is too simple also as regards the inheritance of "pigmented nose." If pigmented nose is, a assumed, due to a simple dominant factor, it should be the easiest thing in the world to get rid of it, by simply breeding from clean nosed animals (recessives). But such is apparently not the case. The author says "Dirty noses are greatly disliked by breeders, who invariably eliminate the bearers of them from their herds, yet dark noses continue to crop up in even the best bred strains of cattle." The experience of Guernsey cattle breeders supports this view.

As regards the assumed one-factor difference between "yellow" and "claret," if the shades of color obtained are carefully classified, it seems doubtful whether segregation will be found to occur on a 1:1 basis. Dunn has not found such to be the case in crosses of yellow with red mice, where similar conditions obtain.

The paper under review is to be highly commended as a pioneer work in a difficult but inviting field, one of practical no less than of theoretical interest, but in the light of the experimental work on rabbits, rats, and mice, the conclusions outlined are to be accepted with reserve, as probably presenting a scheme of modifying factors much simpler than the actual one.



VARIATIONS OF COLOR MARKINGS IN HEREFORD CATTLE

This diagram shows the various grades of pigmentation in Hereford cattle, grade "O" showing the standard or desired amount. The black portions are, of course, intended to represent a deep, rich red. Note how well the coat pattern of the bull in Fig. 27 agrees with the desired pattern indicated by grade "O" in this diagram. Reproduction from Journal of Genetics, Vol. 9, by permission. (Fig. 28.)

GROWING TOMATOES BY TIP-CUTTINGS

George B. Durham

Connecticut Agricultural College, Storrs

THE common garden tomato, *Lycopersicum esculentum*, a native of Central America, Peru, and the southern parts of the United States, has been known by civilization for several centuries. Although its cultivation as a vegetable dates only to the seventeenth century much progress in breeding has been made since that time.

Propagation by all breeders has been by seeds and in a very few cases by cuttings of the terminal buds. In one experiment[1] on tip cuttings vs. plants grown from seed, it was shown that with about twenty plants the average production for the tip cuttings was 75 fruits weighing 163.35 ounces, compared with 53 fruits weighing 148.3 ounces for the plants grown from seed. All plants were started at the same time but the plants from the tip cuttings matured fruits one month earlier than those grown from seed.

PROPAGATION BY BUD SPROUTS

While on this problem the writer conceived the idea of propagating by means of the sprouts from adventitious buds which appeared on the leaves of plants that had been cut back and heavily forced.

Cuttings were taken from the variety "Comet" and rooted in a dark, moist chamber. Within ten days from the time the cuttings were taken, they had formed sufficient roots to insure potting. Later these plants were transferred to the regular raised benches and in 116 days from the day that the cuttings were taken the first ripe fruit was picked.

Within five weeks all the fruits had ripened. In a comparison between the leaf cuttings and ten plants each of "Noroton" and "Farquhars Bountiful," planted alternately in the beds, the following results were obtained:

Variety	*Av. No. Fruits*	*Av. Total Weight*	*Av. Weight*	*Began Bearing*	*Ended*
Leaf cutting	34	176.8 ounces	5.2 oz.	June 10	July 22
Noroton	74	153.5 "	2.7 "	June 14	Aug. 2
Bountiful	43	139.7 "	3.29 "	June 17	July 30

From these leaf-cutting plants other leaf cuttings were taken. These were budded when cut and matured fruit from the first blossoms. They took about six weeks to mature fruit and the total production per plant was about 20 fruits averaging 2.1 ounces. The plants were grown in cold frames and did not seem to thrive so well as the parent plants, due possibly to change in environment.

From these second generation cuttings other cuttings were taken and grown under the same cultural conditions as the original parent. These cuttings were over four inches long and some were in blossom, one of them having set a fruit. This fruit ripened in 31 days from the time the cuttings were taken and weighed only .8 of an ounce. The other fruits were small averaging 1.3 ounces with less than 15 to a plant.

DEGENERATION AFTER FIRST GENERATION

This the author took as sufficient evidence to show that after the first

[1] Stevens, A. T. and Durham, G. B. 1917. Tomato Breeding. Unpublished, on file in Hort. Dept., Conn. Agr. College.

generation the sacrifice of a number of fruits was not offset by the advantage gained by a shortened growing period.

Microscopic examination of 20 of these leaves showed 56-70 bundles at the junction of the petiole and main stem. Each leaflet or sprout is formed by the separation of 4-7 of these bundles from the series in the main system. These 4-7 bundles break up into 16-28 a short distance from the emergence from the main system. The last leaf left averaged eight bundles at the base and 17 in the middle, breaking up as veins emerge.

Flower buds appear 10-30 days after the emergence of the sprout from the stem. Fertile flowers appear in the first cluster.

While the total production and size of the plants decrease nearly 50% each generation the average number of bunles does not decrease.

Summing up the experiment it seems safe to say that plants from leaf-cuttings in tomatoes show a noticeable increase in production in the first generation of cuttings from the parent plant, but do not warrant consideration commercially in succeeding generations.

An Introduction to General Biology

Elementary Biology, by Benjamin C. Gruenberg, Julia Richman High School, New York. Pp. 528. Boston, Ginn & Co., n. d.

Professor Gruenberg has related plant material with animal, including human, material, in a helpful way. His point of view is "that we have to do with constant changes that need to be understood and need to be controlled." He takes great pains to avoid anthropomorphism, as well as to make the work actually interesting.

Naturally so comprehensive a work can not be authoritative in every detail. Thus the remarks about prepotency (p. 307) are antiquated. The account of Mendelism is inadequate, the "law of dominance" in particular being overstated. An allusion to "the American brand of cattle" (p. 451) will be unintelligible to most readers. The list of supposed Mendelizing characters in man is inaccurate. Too much faith is placed in experiments supposed to show how new characters originate (p. 462). The classification of races of man (p. 488) is obsolete.

The principal defect of the book might be considered to be the little attention paid to eugenics which is dismissed with a small paragraph.

Most of the deficiencies of such a textbook will be made up by the instructor, no doubt. If every student in the elementary schools could master the contents of such a book as this, education would produce a better type of citizen.—P. P.

The Social Reactions of Defectives

A Study of Personality of Defectives with a Social Rating Scale, by S. D. Porteus. Publications of the Training School at Vineland, N. J., Dept. of Research. No. 23, Dec., 1920. Pp. 24.

Dr. Porteus gives a convincing criticism of methods of measuring the defectiveness of individuals by mental tests alone. The personality, too, must be taken into account, he insists, and the criteria for this are principally the social reactions of the individual. He therefore presents a scale intended roughly to measure the traits in an individual which may cause social inadequacy. The work is suggestive and interesting, but necessarily inconclusive for the reason that the subjects from which it was made,—namely, pupils at the Vineland Training School—had not been subjected to the actual test of a normal environment in most cases. The bases of judgment are therefore essentially hypothetical.—P. P.

ORIGIN OF THE STRIPED OLEANDER

A. D. Shamel

Riverside, Cal.

THE Oleander, *Nerium oleander* Linn., is widely grown as an ornamental shrub or sometimes trained in tree form in home grounds or alongside roadways in southern California. The plants are very hardy in this district and usually bloom profusely during the summer, and some of them show more or less blossoms throughout the entire year. The flowers are very showy, rose-red, pink, carmine, white, or yellowish in color and occur in terminal cymes. Some of the plants bear beautifully variegated flowers, but the ones usually seen have either white or red flowers. The shrubs usually attain a height of about 10 feet in southern California, but occasionally individual plants have been found which were approximately 20 feet high.

The flowers are salver-shaped and five-lobed when single, and from 1½ to 3 inches across. However, many of the forms seen along the roadside and examined by the writer have been found to possess double flowers with the inflorescence coming out as large,

A STRIPED OR VARIEGATED OLEANDER PLANT

Oleander leaves usually have an even olive-green color, but occasionally a plant has been observed bearing some of its leaves striped with white or golden color. On this plant, grown from a single cutting, are both variegated and green branches all bearing white flowers. The plant was found growing in a row of the ordinary oleanders with green foliage on the Narbonne ranch in the Coachella Valley of southern California. The striped branches have a very striking appearance and are considered more ornamental than the ordinary green plants. (Fig. 29.)

TWO BRANCHES FROM THE SAME OLEANDER PLANT

"Frequently variegated or striped leaves are found on branches of the ordinary green plants." A branch of striped leaves is shown above with a green leafed branch, both taken from the same oleander plant. (Fig. 30.)

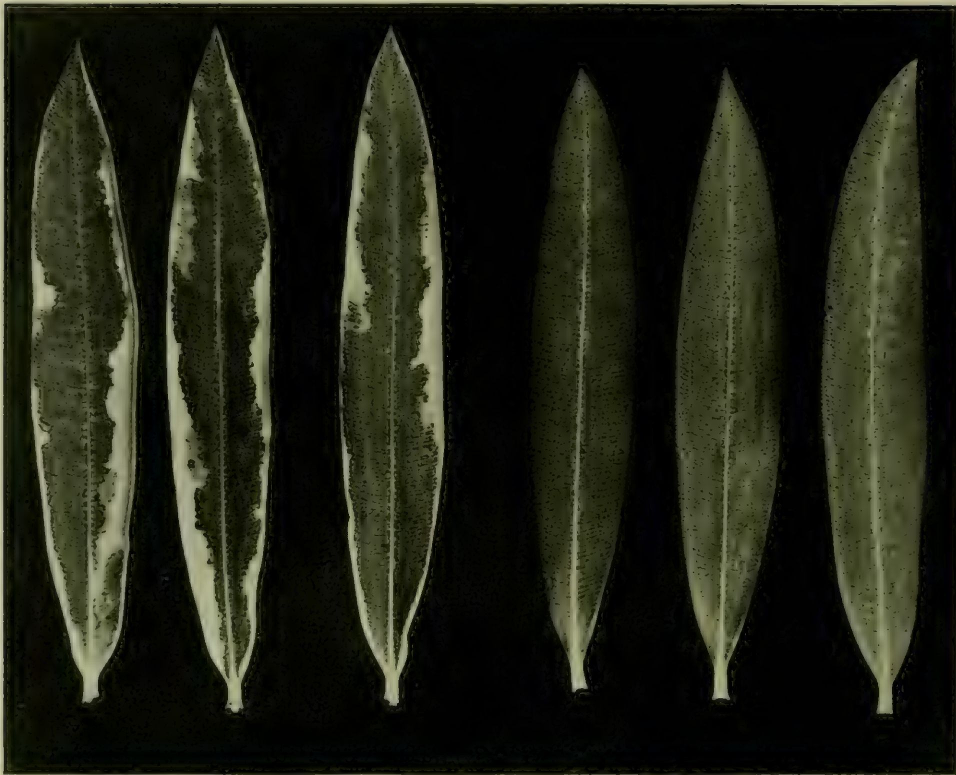
heavy heads. There are usually five stamens attached to the middle tube of the corolla. The seed-pods are cylindrical and contain twisted seeds.

The name is from the Greek word *neros*, signifying humid, to indicate the localities where some of the species grow. *N. oleander* is supposed to be the willow of the scripture.

Oleanders are said to be poisonous and some persons are reported to have died from carelessly eating the flowers. Cattle have been killed by eating the foliage. In California, the oleander is said to be immune from gopher attacks, and the writer can confirm this statement from a limited personal observation of plants in the vicinity of Riverside, Cal. While nearby citrus and other trees have often been found to be attacked by gophers, none of the oleanders examined have been found to show any injuries from or signs of gopher attacks.

The oleanders would be much more widely planted in southern California on account of their persistent habit of flowering were it not for the fact that the plants are very generally attacked by black and other scales. In fact, those insects seem to prefer the oleander to any other plants. In sections where the mealy bug is found the oleanders are also found to be frequently attacked by this enemy of the citrus trees.

The oleander is propagated in southern California exclusively from cut-



INDIVIDUAL LEAVES FROM A VARIEGATED OLEANDER PLANT

The variegated leaves with their alternate white or golden and green stripes present an attractive appearance among the plain leaves of the ordinary variety. (Fig. 31.)

tings. It is as easy to propagate in this way as the willow. The plants are usually given very little attention in this vicinity after planting except adequate irrigation. In the northern and eastern parts of the United States the writer has frequently observed oleanders grown in tubs for summer decoration and commonly used as house plants. The oleander is supposed to be a native of India.

The leaves of the plants observed by the writer have been usually borne in twos and threes, are lanceolate and have an olive-green color. In some plants the leaves are commonly ovate or obtuse.

Frequently, variegated or striped leaves are found on branches of the ordinary green plants. These branches with alternate white or golden and green stripes have a very striking appearance. These branches, according to local propagators, when rooted, produce the striped or variegated plants which are usually considered to be more ornamental than the green form.

On the Narbonne ranch in the Coachella Valley of Southern California, in a row of the ordinary oleanders with green foliage, the writer found a variegated plant of unusual beauty and attractiveness, as shown in Fig. 29. Inasmuch as all of the plants in the row had been propagated from cuttings, it is reasonable to assume that the variegated plant arose from the accidental propagation of a bud sport. In the variegated plant individual branches were observed with the green foliage characteristic of the ordinary variety, as shown in Fig. 30. All of

the variegated plants bore light pink flowers somewhat lighter and more delicate in color than the ordinary red flowers of the green plants. This instance, typical of many others observed by the writer in southern California, illustrates the origin of the variegated forms of the oleander and their propagation from bud variations.

In the catalogue of one of the leading ornamental tree growers of California, seventeen commercial varieties of the oleander are offered for sale. The foliage characteristics of these varieties include green and variegated leaves. Some of the varieties are distinguished by different degrees or arrangement of the variegations. The flower characteristics of the different varieties include white-single, double-white, semi-double white or pink, variegated flowers, carmine-crimson and shaded maroon colors, fragrance or the absence of fragrance, carmine streaked with white color and the production of many or of few flowers. Some, if not all, of these varieties, have been isolated through the selection and propagation of bud sports. In several instances the writer has observed some of these bud variations occurring on the same plant, frequently as branch sports. An inquiry amongst local propagators has revealed the fact that the different varieties listed above have been propagated from bud sports, usually from bud variations of the variegated plants. In one instance a row of variegated plants having both striped leaves and flowers was propagated from cuttings said to have been secured from variegated branches occurring as bud variations in a green leaf and red-flowered plant. However, in most cases the varieties have most frequently developed apparently as selections from bud variations of the variegated plants.

PUREBRED SIRES LEAD RAPIDLY TO IMPROVEMENT IN FEMALE STOCK

Current Results in Federal-State Campaign for Better-Bred Livestock Furnish Striking Facts About Breeding

D. S. Burch

Bureau of Animal Industry, U. S. Department of Agriculture

THAT the use of good purebred sires generally is a forerunner to ownership of well-bred livestock in the various classes and breeds is shown by data assembled by the Bureau of Animal Industry, U. S. Department of Agriculture. The facts and figures compiled are derived from records of the "Better Sires—Better Stock" campaign which, at the close of 1920, had been in progress 15 months. It is a campaign of information with the object of improving the average quality of live stock in the United States. The following facts are believed to be of unusual interest to livestock owners and students of animal breeding:

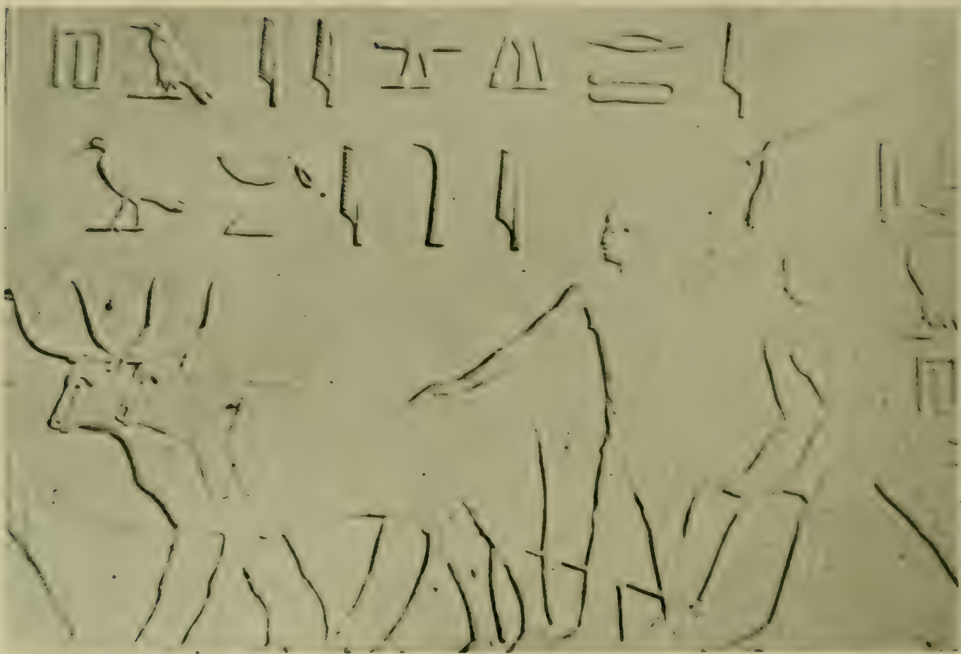
OWNERSHIP OF PUREBRED FEMALES FOLLOWS BETTER SIRES

The use of purebred sires appears to lead automatically to the ownership of a considerable quantity of purebred female stock. The proportion of purebred female animals kept in herds and flocks headed by purebred sires is gradually increasing.

The use of purebred sires apparently results also in the culling out of scrub females, judging from the small proportion of scrub females compared with grade, crossbred, and purebred female animals owned by purebred-sire users.

Of all female stock owned by persons enrolled in the "Better-Sires" campaign at the end of 1920, 55.9 per cent were purebreds, 33.4 per cent were grades, 8.6 per cent were crossbreds, and 2.1 per cent were scrubs. In about a year's time, it appears, the increase in the use of purebred females by purebred-sire owners has been at least 7 per cent.

In the opinion of Department livestock specialists, the more general use



EGYPTIAN CATTLE OF CENTURIES AGO

This picture, from a tomb relief of the 26th Century B. C., shows Egyptian peasants plowing. It is interesting in this connection because it shows the type of cattle which evidently existed at that time. Those depicted here were undoubtedly well fitted for draught purposes, but very far from the type desired for beef purposes. The sway back, thin body and long legs are what breeders throughout the centuries have sought to overcome. (Photograph by courtesy of National Museum.) (Fig. 32.)

of purebreds on farms in the United States is increasing.

The scrub females are believed to be the remnants of former inferior stock before purebred sires were used, since purebred males lead automatically to either purebred, crossbred, or grade offspring, depending on the bloodlines of the females used.

It is noteworthy that the largest proportion of female stock of pure breeding occurs in the case of the smaller and more prolific animals. In poultry the proportion of purebred females to all females was 70.5 per cent, and in swine 65.4 per cent. The corresponding figure for cattle was 37 per cent, and for horses 11.9.

Comments accompanying blanks of enrollment indicated that many livestock owners had used purebred sires for a considerable period, which explains the low percentage of scrubs. This evidence points strongly to the influence of purebred sires on improvement in quality of herds and flocks.

SHOWS RESULTS OF STATE WORK FOR BETTER BULLS

The drive which many States have been waging against scrub bulls was reflected in the figures of the Department. More purebred bulls were enrolled in the "Better-Sires" movement than any other sires except poultry. At the end of December, 1920, there were enrolled in the "Better-Sires–Better Stock" campaign 156,832 animals, and, in addition, 238,122 poultry.

RATIO OF SIRES TO DAMS

Developments of the campaign have resulted also in figures showing the relative number of males and females kept on farms for breeding purposes. Following are the ratios based on nearly

ANOTHER TYPE OF EARLY EGYPTIAN CATTLE

According to ancient carvings, this is one kind of cattle raised in Egypt centuries ago. Note the depth of body and blocky conformation of this animal, in contrast to those on the opposite page. This one shows several characteristics desired by modern breeders. Evidently it was the Egyptians' beef type of cattle, and this one is shown being led to slaughter. (Photograph by courtesy of National Museum.) (Fig. 33.)

400,000 head of livestock and poultry listed with the Department:

Cattle.....1 bull to 17.5 cows.
Horses....1 stallion to 17.2 mares.
Swine.....1 boar to 11.1 sows.
Sheep.....1 ram to 32.3 ewes.
Goats.....1 buck to 23.9 does.
Fowls.....1 rooster to 23.9 hens.
Other poultry,
geese, ducks,
turkeys, etc.
(average)..1 male to 10.6 females.

FACTS OBTAINED WITH SPECIAL CARE

Knowledge of the breeding of livestock in the "Better Sires–Better Stock" campaign is obtained with special care. First, the owner of the stock lists his animals kept for breeding on the enrollment blank in accordance with the official definitions for the various classes of animals with respect to their parentage. As the better-sires slogan indicates, all males must be purebred and of good quality.

Female stock may be of any breeding and spaces are provided for the listing of purebred, grade, crossbred, and scrub females. Then the classification is approved by the county agent in the county where the livestock owner lives. In the relatively few cases where there is no county agent, the written indorsement of the blank by two experienced and disinterested livestock owners is required.

Every person agreeing in writing, on the blank furnished, to use only purebred sires in his breeding operations receives an emblem of recognition issued cooperatively by the United States Department of Agriculture and the State in which he lives. So-called "red tape" has been reduced to a minimum and the emblems have been issued in most cases the day the blanks were received.

FEMALE STOCK NEED NOT BE PUREBRED

Though pointing out the foregoing observations—and especially the ten-

ASSYRIAN HORSES IN ACTION

This picture is from a marble slab carved more than six centuries before the Christian Era The horses of that time, according to the carving, were of a better type than many of the scrub and grade horses now used by farmers in the United States. (Courtesy of National Museum.) (Fig. 34.)

dency for purebred-sire owners to acquire purebred females—the Department of Agriculture does not urge purebred female stock on the average farm. Whether purebred females should be kept is a matter of individual judgment, depending on circumstances which the livestock owner is best able to know. The successful breeding of purebred livestock as a business calls for close attention and considerable experience, both in production and marketing. By contrast, the purpose of the better-sires movement is to raise the average quality of all livestock in the United States.

The Department therefore goes no further than to urge the use of good purebred sires. It believes that after having taken that step livestock owners will continue to improve their domestic animals, raising either grades, crossbreds, or purebreds—or some of each—whichever seems best suited to the kind of farming followed, and to available markets.

In connection with the foregoing recommendation the Department points out that the breeding of good livestock is by no means a new industry. Ancient carvings show classes of domestic animals which appear to have been very creditable, and, judging from obtainable evidence, some of the animals centuries ago were of better type than the more inferior animals in the United States today. This fact points out the need for continued study and the use of good breeding stock. Economic conditions of today require the most efficient live-stock we can produce.

The

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CONTENTS

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ROUND TIP TOBACCO AT THE LEFT COMPARED WITH HAVANA TOBACCO AT THE RIGHT

Here is a good illustration of the plant breeders' art. Three essentially different requirements were met in the production of a new tobacco now known as Round Tip which produces the finest cigar wrappers in the United States. The manufacturers and consumers of cigars have thus been satisfied as well as the growers who demand a strong, many-leaved, disease resistant plant. The new hybrid is shown at the left in the photograph. Compare its leaves with those of the Havana plants at the right. (Frontispiece.)

ROUND TIP TOBACCO—
A PLANT "MADE TO ORDER"

From Specifications Drawn by Manufacturers and Consumers of Cigars, and the Growers of Tobacco, a New Plant is Grown to Satisfy the Demands of Commerce.

E. M. East,
Bussey Institution, Harvard University, and
D. F. Jones,
Connecticut Agricultural Experiment Station

A NEW type of cigar wrapper tobacco known to the trade as Round Tip, has given such evidence of commercial success that its origin may be of some interest, particularly as it is one of the few instances where a plant was actually made to order with the specifications drawn beforehand.

The manufacturer of cigars, knowing the demands of the consumer, calls for numerous qualities in the leaf he uses to enclose his wares. Primarily of course, it must burn rather freely—but not too freely—and must leave a gray-white ash which does not flake off at each puff of the ultimate consumer. The flavor must be of that peculiar character acceptable to the connoisseur, which may be described as neither earthy nor bitter but somewhere in between. Possession of the delicate aroma so dear to the heart of the confirmed smokers is not essential. The aroma of a cigar is furnished by the leaf used as filler; but the wrapper must have an agreeable aroma or none, since the most delicately perfumed filler ever produced may be utterly ruined by a nauseous wrapper. It must have a velvety texture, and a uniform color—not too dark nor yet too light. It must be greenish-brown rather than reddish-brown, and above all must not be coarse veined or show white markings around the veins.

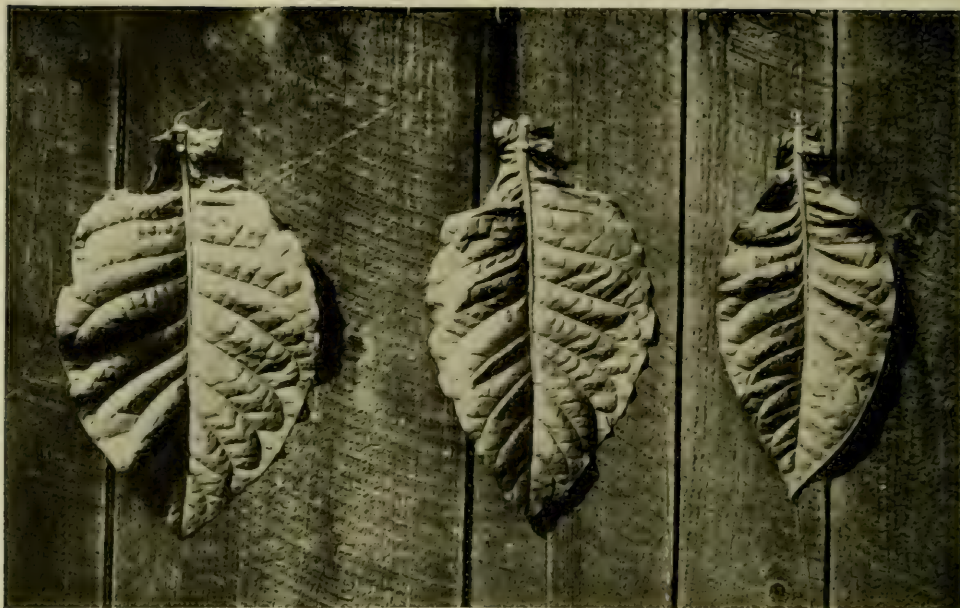
THE MANUFACTURER'S SPECIFICATIONS

So much for the demands of the consumer. Comes now the manufacturer, pressing his needs. Cigar wrappers cost money, and he must have a thin leaf covering as many cigars as possible per pound of material. The leaf should be broadly rounded at the tip, since the wrapper of finest quality comes from this portion of the blade. Again, the cigar wrapper must be strong and full of elasticity. It shaves down the profit to have a significant percentage of torn leaves come from the wrapping bench. If the purchaser breaks the wrapper in his pocket, all very well, provided he doesn't do it often enough to prevent his coming back for more; but broken leaves in the factory break the heart of the manufacturer.

THE GROWER'S DEMANDS

Finally, enter the farmer. His demands are always last to be considered, since the common practice in our national drama is to cast the farmer in the rôle of "goat" instead of giving him the star part he deserves. The grower demands a plant of quick maturity, a plant with many leaves, a plant with no lateral branches. His ideal is a strong plant standing up under wind and rain, a plant resistant to disease, one which will fill his barns to overflowing and cut down the unit growing cost.

In the narrow basin of the Connecticut river, on the land between Holyoke, Massachusetts, and Glastonbury, Connecticut, they grow the finest cigar wrappers in the United States. And this is really quite an odd fact. The two regions most famous for cigar wrappers are Sumatra and Cuba. The first is astride the Equator; the second is just south of the Tropic of Cancer. Then away up at forty-two degrees north latitude is this spot bidding fair to rival them, a place where soil and climate again combine to make matters right for the sovereign weed. Here some 35,000 acres are grown which bring the planters higher returns than



LEAVES OF SUMATRA TOBACCO—ONE OF THE PARENTS OF ROUND TIP

Sumatra and Cuba are the two most famous regions producing tobacco for cigar wrappers. Sumatra tobacco, while grown in the Connecticut valley, does not compete commercially with the other varieties. It, however, possesses some most desired and promising qualities, and was used as one of the parents of Round Tip. The illustration shows bottom, middle and top leaves from a Sumatra plant. (Fig. 1.)

any other place of equal area on the globe.

FOUR DISTINCT VARIETIES OF TOBACCO IN THIS DISTRICT

The Connecticut valley confines its attention to three markedly different types known as Cuban, Havana seed and Broadleaf. A fourth type, Sumatra, has been tried commercially at various times, but has not been able to compete with the other varieties. It must be considered in our discussion, however, for it has certain qualities not possessed by the others.

Four tobaccos then form the basis of the nicotinous wealth of this little district. Unfortunately, like most mundane objects, each has its defects. The Sumatra wrapper leaf, though very popular with the manufacturers in this country, is small, thin and tasteless. It requires an expensive cloth-shaded field to obtain the moistur econstancy needed for proper development, and gives a comparatively low yield after all th s trouble has been taken n ts behalf The var ety known as Cuban s somewhat similar to Sumatra and must also be grown under shade. Its somewhat larger, thicker, stronger and better flavored leaf makes it more desirable than Sumatra, but the relatively low yield and expensive equipment results in a much smaller net cash return to the farmer than he ought to have.

Sumatra and Cuban average about twenty leaves each; Havana seed and Broadleaf, which are grown without shade-cloth, have one or two leaves less. The last two are similar to each other. Just as Sumatra and Cuban form one group of tall and relatively small leafed plants, Havana seed and Broadleaf form a second group of short plants having large coarse-grained leaves. The Broadleaf blade is lance-ovate, and drooping, and is thus not well fitted for economical wrapper cutting. On the other hand, the large leaves (reaching 34 inches) when not too thick and coarse, have the finest

BROADLEAF TOBACCO—THE OTHER PARENT OF ROUND TIP

Very different are the characteristics of Broadleaf tobacco leaves as compared to Sumatra leaves shown on the opposite page. The leaves of Broadleaf are large and thick, of coarse texture and strong flavor while Sumatra leaves are small, thin and without flavor but possessing the round tips. The hybrid of the fourth generation from the crossing of these two plants is what is now called Round Tip. (Fig. 2.)

texture and flavor of all wrapper tobaccos. The Havana seed leaf is somewhat less coarse than the Broadleaf and is not quite so pointed at the tip

PRODUCING A NEW TYPE

The situation in the valley, then, has been this: Four varieties have been grown, each is imperfect in itself, but differing from each other in such a way that there was the possibility of combining the best characteristics into a single type of marked excellence. A co-operative plant breeding project was undertaken by the Connecticut Agricultural Experiment Station, Harvard University and the United States Department of Agriculture, therefore, with this object in view.

After examining the possibilities inherent in all four varieties, Sumatra and Broadleaf were selected as the two parents most promising in their qualities. The chief characteristics in which the two varieties differ, and the qualities which it was hoped might be obtained were as follows:

Broadleaf	*Sumatra*	*Prospective type*
large leaf	small leaf	large leaf
narrow tip	round tip	round tip
drooping leaf	upright leaf	upright leaf
leaves close	leaves apart	leaves close
texture coarse	texture fine	texture intermediate
leaves thick	leaves thin	leaves intermediate
flavor good but strong	flavor none	flavor intermediate
yield high	yield low	yield high

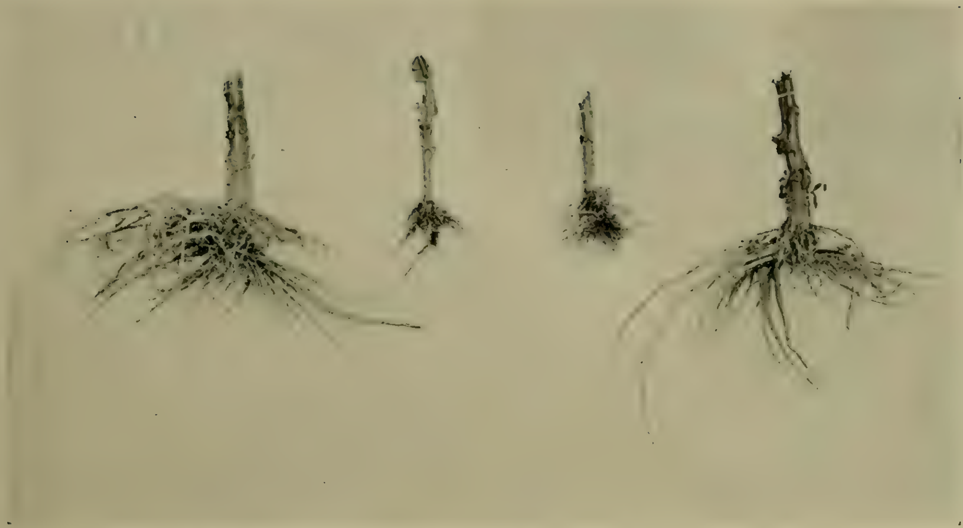
ROUND TIP TOBACCO SHOWING UNIFORMITY OF GROWTH

This new type of tobacco has produced 2,800 pounds per acre under ideal conditions as compared to about 1,500 pounds per acre from types that are commonly grown. It has a greater number of leaves, ovate in shape, thus affording a greater yield of cigar wrappers. (Fig. 3.)

The two varieties were crossed and a small first hybrid generation grown. The plants were uniformly intermediate in type, though perhaps approaching the Sumatra rather than the Broadleaf. They grew very quickly, and apparently did not possess a very desirable root system since a slight windstorm would send them to the ground. The leaves were very coarse-veined and worthless commercially. The second hybrid generation was extremely variable, transcending the grand-parental limits in such characters as leaf numbers. Among the plants of the second hybrid were about twenty with the characteristics desired so far as one could tell from field observation. Selfed seed from these individuals was obtained, and a number of F_3 families tested. Some were variable, some were apparently constant. After careful statistical study in the field, half a dozen selections were carried to the fourth hybrid generation and further eliminations made after the leaves had been sorted and cured. The selection surviving this fine-grained seive was named the Round Tip.

QUALITIES OF THE NEW TYPE

The new tobacco possesses a leaf nearly as large as that of the Broadleaf when grown on fertile soil. Its leaves



SHOWING ROUND TIP'S GREATER RESISTANCE TO ROOT ROT

These are the roots of average plants taken from one field infected with root rot. Those on the outside are Round Tip and those on the inside Havana tobacco. The grower demanded a plant resistant to disease, and one which would stand up under wind and rain—qualities which are prominent in the new tobacco. (Fig. 4.)

ROUND TIP TOBACCO LEAVES

In comparing these leaves of the new hybrid with those of the two parents shown in Figs. 1 and 2, the immense increase in cigar wrapper surface is plainly shown. These are bottom, middle and top leaves from a Round Tip plant. Wrappers made from Round Tip leaves cannot be distinguished from the high grade Sumatra wrappers. (Fig. 5.)

are ovate instead of lanceolate, thus increasing the yield of cigar wrappers. The average leaf number is 26 instead of 19; and the leaves are upright instead of drooping, though they are not grouped together on the stalk as closely as might be desired. The strength, elasticity, grain and color of the cured article is all that could be wished. The lighter colored leaves of a greenish shade are indistinguishable from high grade Sumatra wrappers in appearance, though possessing somewhat better texture and flavor. At a meeting of tobacco growers recently, cigars wrapped with Round Tip could not be separated from cigars wrapped with Sumatra by the most distinguished tobacco experts present. The darker leaves of the brownish grades are very like imported Cuban wrappers, but in the opinion of many have a better burning quality. Crops of 2,800 pounds per acre have been secured, though these were obtained under extraordinarily good conditions. Under average growing conditions yields of about 2,000 pounds per acre may be expected. When it is realized that the types commonly grown yield only about 1,500 pounds, the increase is notable.

It remains to be seen whether a new tobacco of this kind can be introduced to such a conservative market as that to which it must be offered. But the type has now had a three year test, satisfying the requirements of some thirty planters who have grown it on considerable areas. It is as uniform in type as any of the older varieties and possesses, besides the market requirements mentioned above, some field characters which delight the grower. Not the least of these is a wonderful root system making it stand up under winds that lay other tobaccos low, and a resistance to root rot which came to it by accident rather than by design of the plant breeder. One prominent grower says of it: "If it does not largely replace other tobaccos of the Connecticut River district in the near future and add millions of dollars to our wealth, it will be because of timidness on the part of the buyers who have been taught that anything new in the tobacco trade is something to be shunned."

BREEDING EARLESS SHEEP

Chr. Wriedt
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In the Journal of Heredity, Vol. XI, No. 5, Prof. E. G. Ritzman reported that short-eared sheep, in inbreeding, have given earless offspring. This result was reported by the writer in 1918,[1] who also advanced the hypothesis that the earless sheep was the homozygote and the short-eared was the heterozygote.

The results of breeding experiments for 1920 and 1921 are as follows: One earless ram mated with normal sheep gave five offspring with short ears. One earless sheep mated with a normal ram gave one offspring with short ears. A mating earless × earless has given two earless offspring. The hypothesis that the earless sheep is the homozygote and the short-eared is the heterozygote of normal × earless mating is thus nearly proven by this result.

Short ears in sheep were formerly very common in Norway. The writer[2] has found this type in the south, in the middle and in the west of the country, and also has information that the type has spread in the north. Dr. Duré has, according to Adametz,[3] found the type in Bochara in the Karakul breed. Adametz mentioned also that Iwaneieff had seen the earless type in the same breed.

[1] Chr. Wriedt 1919. Über die Vererbung von Ohrenlänge beim Schafe. Zeitschrift für Induktive Abstammung und Vererbungslehre Band XX Pag. 262–63.

[2] Chr. Wriedt 1914. Über die kurzohrige Schafrasse Norwegens. Jahrb. f. wissenschaftliche und praktische Tierzucht IX S. 266–267.

[3] Leopold Adametz 1917. Studien über die Mendelsche Vererbung der wichtigsten Rassemerkmale der Karakulschafe bei Reinzucht und mit Rambouillets. S. 152–153.

INHERITANCE IN SWINE

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ONE among the many casualties of the Great War, which will not be found listed in the files of the War Department, was the stopping of a certain extensive experiment in swine breeding which was conducted at the Kansas Experiment Station under the direction of Mr. E. N. Wentworth until the spring of 1918 when the last of the persons in immediate charge of the work entered military service. That ended the taking of detailed records and the subjects of the experiment continued their growth, matured, and were marketed, so that it was impossible to resume the experiment at the point at which it stopped.

SOME VALUABLE CONCLUSIONS REACHED

However the experiment was not a complete casualty for the results already secured in four years of breeding make a few conclusions almost inescapable and point to others which can perhaps be verified, one at a time, by a few well-chosen crosses. This is particularly fortunate because there have been so few genetic experiments on swine which have gone farther than the production of a very few F_2 litters, and yet swine are very suitable for studies in heredity, not only because of their economic importance, but also because of the rapidity of their multiplication and the wide diversity of true-breeding forms and colors which they offer to the investigators.

The experiment was undertaken with the idea of securing information about the inheritance of all the well-defined characters which differed in the breeds used, but conclusions have been reached only in regard to the shape of face, set of ears, color, growth factors, and litter size. The most of the work was done on crosses of a registered Berkshire boar on registered Duroc-Jersey and Tamworth sows, but the problem of litter size was separately attacked by mating European wild boars of the Schwarzwald type to Tamworth and Berkshire sows.

LITTER SIZE

The use of the wild boar for investigating this economically important character was originally suggested by an investigation by Wentworth and Aubel[1] in which it appeared that the distribution of the various litter sizes among ordinary domestic swine did not conform to the normal frequency curve. Since the wild hog ordinarily produces four pigs per litter, it was decided to cross a boar of this kind upon sows of one of the more prolific of the domestic breeds, such as the Tamworth which ordinarily produces about eleven pigs per litter. There were thirty-eight F_1 pigs produced in this cross, but only one of the females among them had reproduced before the experiment ended. The fact that her litter consisted of but four pigs, taken in connection with the fact that Simpson[2] reports litters of four, six, and four, respectively, from three sows of the same kind of breeding, gives an indication that the wild litter size is dominant, but tells us no more about its inheritance.

SET OF EARS

The Berkshire, Tamworth and wild hog all have erect ears of fine or moderately fine texture, and since all the pigs produced by crossing these three breeds possessed a very similar sort of ear, they throw no light upon its inheritance. The Duroc-Jersey, however, possesses a distinctly different sort of ear which is not so pointed, is of medium size, and breaks over at

[1] Wentworth, E. N. and Aubel, C. E. Inheritance of Fertility in Swine. *Journal of Agricultural Research*, Vol. 5, No. 25, pp. 1145–1160.

[2] Simpson, Q. I. 1912. Fecundity in Swine. *Am. Breeders' Association*, Vol. 7, pp. 261-275.

SOME WEANLING PIGS FROM A WILD BOAR FATHER AND POLAND CHINA MOTHERS

The swine breeding experiments described in this article were conducted to determine the inheritance of certain well-defined characters which differed in the several breeds used, such as color, shape of face, set of ears and litter size. The economic importance of some definite knowledge regarding rate of growth as well as the greater size and vigor of the hybrids for market purposes was recognized throughout the experiments and some significant data secured. Photograph by courtesy of the Iowa Experiment Station. (Fig. 6.)

about one-third of the distance from the tip to the base, so that the outer third droops downward. There is quite a bit of variation within the breed but this is closely associated with variation in the general quality of the animal. That is, the coarser ear more than one-third broken over is usually found on the coarser, rougher animals, while the finer, more pointed ear, broken over less than one-third, is found more often on a lighter-limbed, rangy type of hog. Whether this correlation is genetic (linkage) or due simply to the mechanics of growth is not known.

The twenty-nine F_1 pigs of the Berkshire × Duroc-Jersey cross, except for one boar and one sow in the first litter (which was sired by a boar not used subsequently, and which was discarded for breeding purposes), all possessed ears which were perfectly erect but slightly larger than on Berkshires of equal size.

Only forty-two F_2 individuals were mature enough to determine definitely the shape of the ear when the work was discontinued. Of these, only one showed a typical Duroc-Jersey ear, several were intermediate, but the great majority possessed ears as erect as the Berkshire.

The F_1 boar when mated back to his dam, sired three litters totalling thirty-five pigs, nine of which had lived to be as much as six months old when the experiment ended. Of these, four had typical Duroc-Jersey ears, one was still undetermined, and four had erect ears.

The following conclusions in regard to the inheritance of the set of ear seem warranted by the data: The typical erect ear of the Berkshire is dominant by at least one and probably not more than three (F_2 ratio of forty-one erect or intermediate to one of Duroc-Jersey type) principal factors. There may be a number of minor modifying factors for size and quality as well as for the amount of breaking over. Neither breed is homozygous throughout for all the factors concerned in the

A WILD BOAR AND ONE OF HIS PROGENY FROM A DOMESTIC TAMWORTH SOW

European wild boars were used in these breeding experiments to determine the inheritance of litter size. Wild sows ordinarily produce only about four pigs per litter which is much less than is produced by sows of the domestic breeds. Tamworths farrow on the average about eleven pigs. The picture shows the wild boar used (at the right) with one of his crossbred sons. (Fig. 7.)

production of its own peculiar ear shape; i.e., being purebred is not equivalent to being homozygous in this respect.

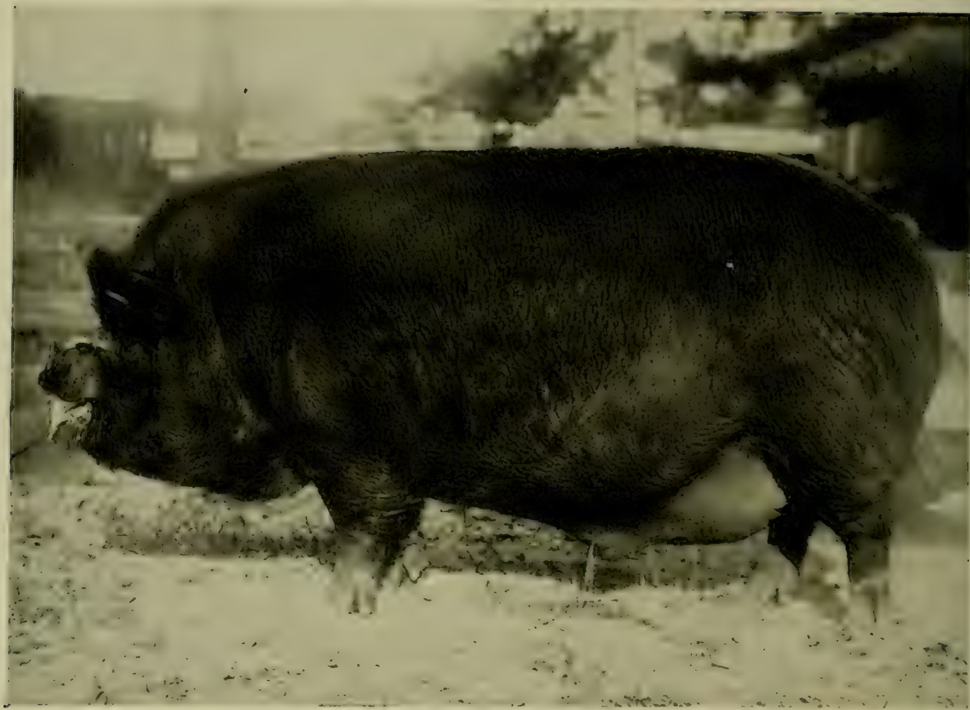
SHAPE OF FACE

This character, like the set of ear, does not complete its development until the animal is mature, and is fairly constant within each of the breeds of swine. Both the Tamworth and the wild hog are characterized by long narrow straight faces with no forehead prominence. The Wild face is the more extreme in each of these three respects, and the seven mature F_1 pigs all approach very closely to the face shape of their wild parent.

Among the common breeds of swine in America the Berkshire represents the opposite extreme to the wild hog in face shape, having a very short, extremely dished face and a forehead so broad and prominent as to give it a sort of pompadour appearance. Only two pigs from the Wild × Berkshire cross matured and both resembled the wild parent so closely that, except for color and wider foreheads, they would have been indistinguishable from the Wild × Tamworth F_1's.

Seven pigs of the F_1 generation of the Berkshire × Tamworth cross matured and could not be distinguished from the purebred Tamworths as far as face shape was concerned. This is especially surprising because Simpson[3] who crossed Tamworths and Large Yorkshires (which have a face shape similar to the Berkshire in outline although longer), reported that the result was an intermediate face shape. He does

[3] Simpson, Q. I. and J. P. 1909. *Am. Breeders' Association,* Vol. 5, pp. 250-5.



A TYPICAL BERKSHIRE BOAR

In addition to the wild hog, the Berkshire, Duroc-Jersey and Tamworth breeds were used. A photograph of the registered Berkshire boar used is not now available, but the above illustration shows a typical boar of this breed. Its ears are erect like those of the Tamworth and wild breeds. Photograph from U. S. Dept. of Agriculture. (Fig. 8.)

not give the numbers for an F_2 generation and none of the F_1 individuals in this experiment reproduced, hence there is not even an indication of the number of factors responsible for the face differences in these three breeds. However the data clearly indicate this much: Tamworth long straight face is dominant over Berkshire short dished face; Yorkshire dished face forms an intermediate F_1 with Tamworth long straight face; therefore Berkshire short dished face and Yorkshire dished face must be similar phenotypes produced by somewhat different factor complexes.

The face shape of the Duroc-Jersey is intermediate to that of the breeds just discussed in that it is moderate in length and in dish, while the forehead and the hair which grows upon it usually slope smoothly upward and backward. In the F_1 generation of the Berkshire × Duroc-Jersey cross, the forehead in every case approached closely that of the Berkshire type and the face was strongly dished but not quite to the degree of the Berkshire ideal. There was some variation in dish and in length of face among the F_1s but they were all pronounced enough to be more Berkshire than Duroc-Jersey in type. In the F_2 generation very much wider variation was observed. Since no practicable means of measuring these three elements of face shape was discovered, they were simply classified according to their resemblance to one or the other of the grandparental types. Table I shows the result:

TABLE I

Character	Similar to Berkshire	Inter-mediate	Similar to Duroc-Jersey
Forehead Shape	37	2	3
Dish of Face	17	9	16
Length of Face	21	7	14

THE PUREBRED DUROC-JERSEY WHICH WAS THE MOTHER OF THE FIRST F_1 AND BACKCROSS GENERATIONS

The Duroc-Jersey breed possesses drooping ears in contrast to the erect ears of the other breeds used. All except two of the 29 pigs of the first generation from the Berkshire × Duroc-Jersey cross had erect ears. (Fig. 9.)

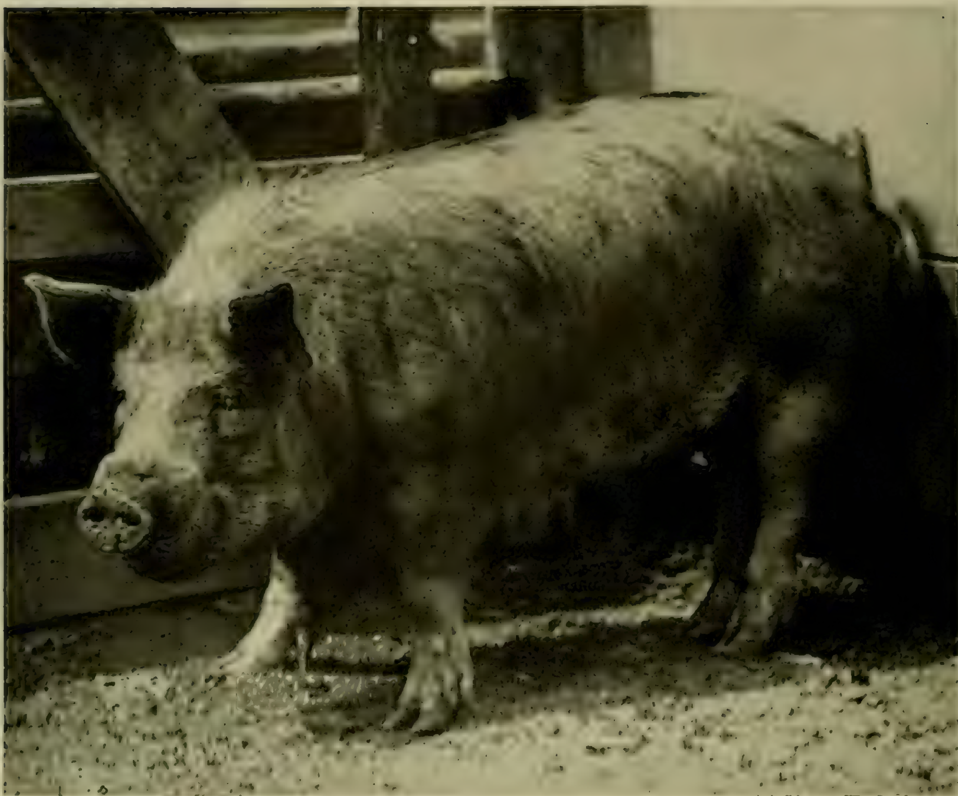
Of course it is likely that some of these groups may contain more than one phenotype, since the characters are not definitely measurable ones, but the variation from one extreme to the other was by no means continuous and the investigators believe that the number of phenotypes which result from this cross is quite limited. There was some evidence of correlation between length of face and dish of face because hogs with both extremely dished faces and extremely long faces did not occur, but on the other hand, short-faced hogs occurred with both extremely dished and extremely straight faces. This probably means that such correlation as may exist is developmental or anatomical rather than genetic (linkage).

Other conclusions which may be drawn with respect to face shape are these: Several factors differing in importance and in degree of dominance are responsible for the anatomical differences which have been considered under the title of face shape. Certain of these factors affect certain parts of the face much more than they do other parts. The number of these factors can not be so very large, else the parental types would not have been recovered among such limited numbers.

SWINE COLOR

The carefully controlled experiments on swine which throw any light upon the inheritance of the various colors are not numerous and the resulting interpretations which are established beyond any scientific doubt are few indeed. The whole subject has been reviewed recently in the *Journal of Heredity* by Wright[4] and, as far as the author knows, since then there has been only one notable addition to the literature upon the subject;[5] therefore what seems most likely to be the truth about the inheritance of the different colors found in swine will be very briefly summed up as follows:

[4] Wright, Sewall. 1918. Color Inheritance in Swine. Journal of Heredity, Vol. 9, pp. 33-38.
[5] Lloyd-Jones and Evvard. Iowa Agricultural Experiment Station, *Research Bulletin*, No. 53.



A CROSSBRED FROM THE BERKSHIRE × DUROC-JERSEY CROSS

This boar was the father of the second and backcross generations. Compare it with its parent breeds shown in Figs. 8 and 9 and note its color, erect ears and intermediate face shape. (Fig. 10.)

White: There are at least three kinds of white which are genetically distinct. Self white is dominant over all other colors with which it has been crossed and is probably dependent upon only one factor. White belt (as seen in the American Hampshire or in the German Hanoverian swine) is usually dominant but must depend upon at least two factors since belted offspring sometimes result from non-belted parents. The white which is best illustrated in the "six white points" of the Berkshire or Poland-China, seems to be an extremely diluted red or the absence of all shades of red. The author has found no record of true albinism in swine.

Black: There are certainly two and very probably three kinds of black. Self black (as in the English Large Black swine) is reported dominant to Tamworth red. The black which is associated with the white belt in the American Hampshire is dominant to Duroc-Jersey red and depends upon a single factor. There is no evidence as to whether these two kinds of black are genetically distinct, or the latter is merely self black plus the additional unknown factors for white belt. The black of the Berkshire and Poland-China is certainly distinct from both the preceding kinds since it always breaks up, when crossed with red, into numerous black spots scattered over a lighter background, usually red or sandy but sometimes white.[6] This black, as will appear from the results of this experiment, is caused by a

[6] SEVERSON, B. O. 1917. Color Inheritance in Swine. JOURNAL OF HEREDITY, Vol. 8, p. 379.

A BERKSHIRE X DUROC-JERSEY CROSS SHOWING A SHORT STRAIGHT FACE (Fig. 11)

ANOTHER BERKSHIRE X DUROC-JERSEY CROSS

This is a first generation boar with drooping ears—one of the two out of the 29 first generation pigs which did not have erect ears. (Fig. 12.)

A SECOND GENERATION BERKSHIRE X DUROC-JERSEY CROSS

An illustration of the appearance of the Berkshire type of forehead in the second generation. Contrast with the different type shown in the following figure. (Fig. 13.)

single factor which alone produces black spots irregularly scattered over a lighter ground color and, when extended by the action of various modifying factors, it covers all the body except the "six white points." Reasoning from the similarity in appearance and ancestry rather than from any definite experimental data, the Spotted Poland-China possesses the same fundamental factor for black spots but many of the factors which influence the size of those spots are absent.

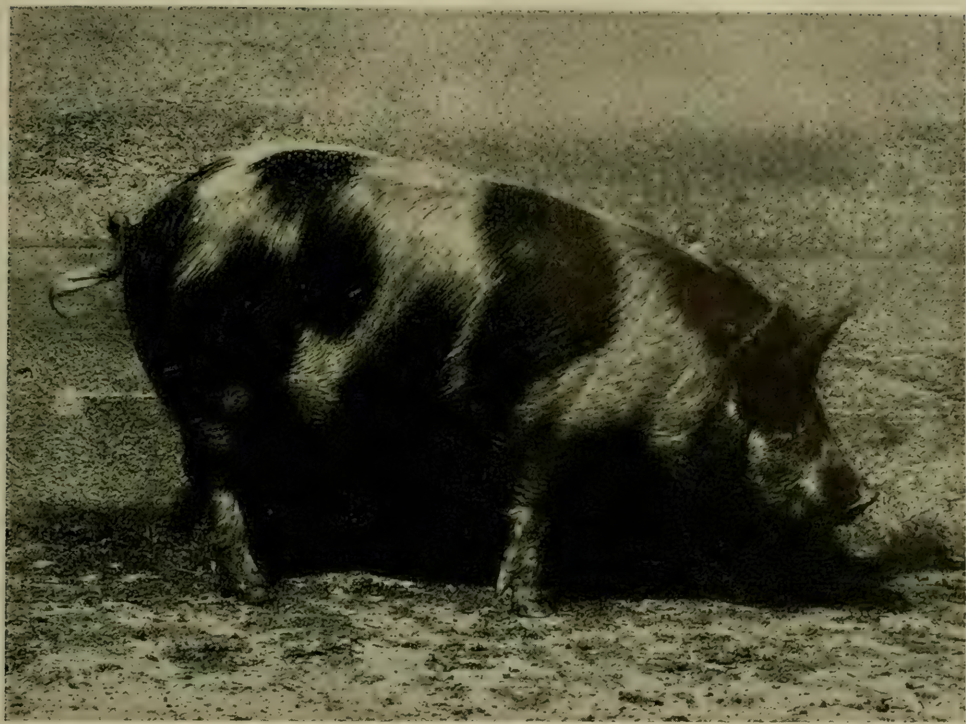
Red: Two kinds of self red are genetically distinguishable by their behavior toward self white. Possibly the factors which affect the white are distinct from the factors for red. Differences in the intensity of the red seem to be inherited but there are no experimental data to back up that popular opinion.

Roaning: Appears quite frequently among the descendants of self whites by self reds, or of self whites by belted blacks. Often it is not apparent at birth but develops later.

Immature Striping and Adult Agouti of the Wild Hog: This pattern is dominant over all other co'ors except self white and the white belt, but the dominance is not always complete.

COLOR RESULTS FROM THIS EXPERIMENT

The European wild hog is of a color corresponding very closely to the agouti or gray pattern common among many other wild mammals, except that in this case it is an uncommonly dark slaty shade. Another interesting feature is that the young are born with longitudinal stripes about a centimeter wide running the full length of their bodies and extending over all the back and sides, but with very light bellies. This is quite evidently a protective coloration for at a short distance they blend in very well with the sticks and trash on the ground. The contrasting

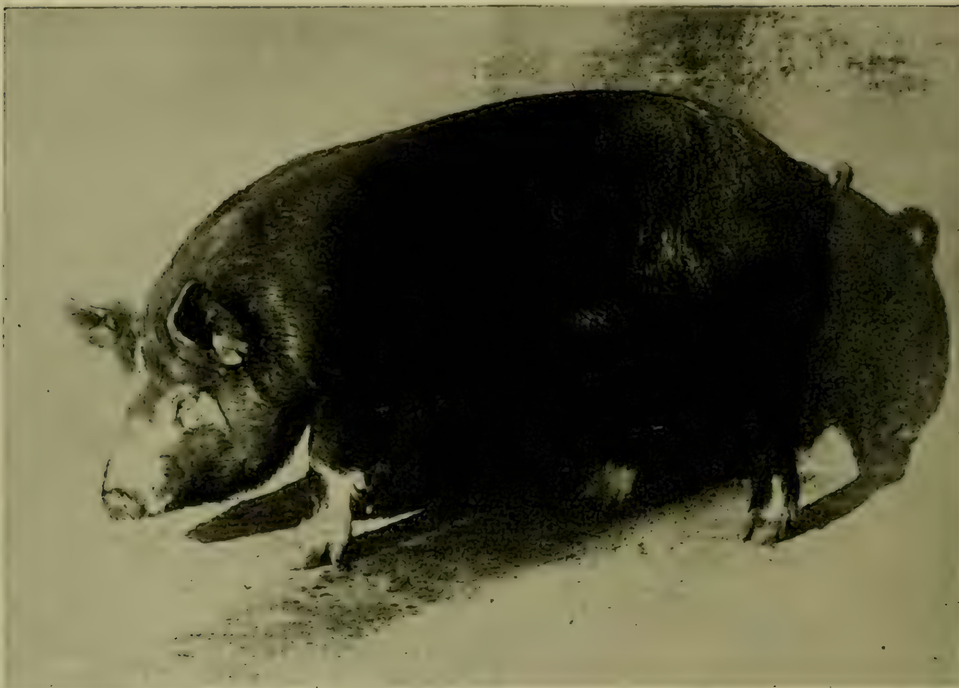


A BERKSHIRE X DUROC-JERSEY CROSS

An example of the re-appearance in the second generation (Berkshire×Duroc-Jersey) of a long straight face similar to that of the Duroc-Jersey. The first cross was closer to the Berkshire than to the Duroc-Jersey in length and dish of face and shape of forehead. Various combinations segregated out in the second generation. (Fig. 14.)

stripes were brown and sandy on all the thirty-eight pigs produced by crossing the wild boars upon purebred Tamworth sows. They were quite uniform in color. However, on the seventeen pigs produced by crossing the wild boars on purebred Berkshire sows, the bellies and light stripes were a very light sandy, almost white, and the darker stripes were a darker brown; that is, there was less of a reddish tinge throughout and, in addition, there were large black spots scattered all along the whole under surface. This is most readily interpreted as meaning that the wild pattern is not completely epistatic but lets the Berkshire black spots develop along the underline and allows the Tamworth red to show up in the reddish tinge of the offspring from that cross.

Four F_2 pigs, all striped but of different belly colors, were produced in the Wild×Tamworth cross. One had a very light, almost white, belly (presumably lacking the Tamworth factor or factors for red), two were like the F_1s, and one was like the F_1s except that it had some large black spots in both hair and skin scattered along its belly. There was one backcross litter by an F_1 boar of a purebred Tamworth sow. Three of these were faintly striped and possessed small black spots on their bodies, two were like the F_1s, two were red with small black spots, and one was self red. This seems to mean at least two independent factors —one for black spots and one for the striping pattern—and another factor for intensity of the striping which may be linked to the factor for black spots.



THE SECOND GENERATION PIG WHICH SHOWED THE MOST BLACK (BERKSHIRE X DUROC-JERSEY CROSS)

The first generation was composed wholly of red pigs with black spots. There was much variation in the second generation of which the case illustrated above is an extreme example. (Fig. 15.)

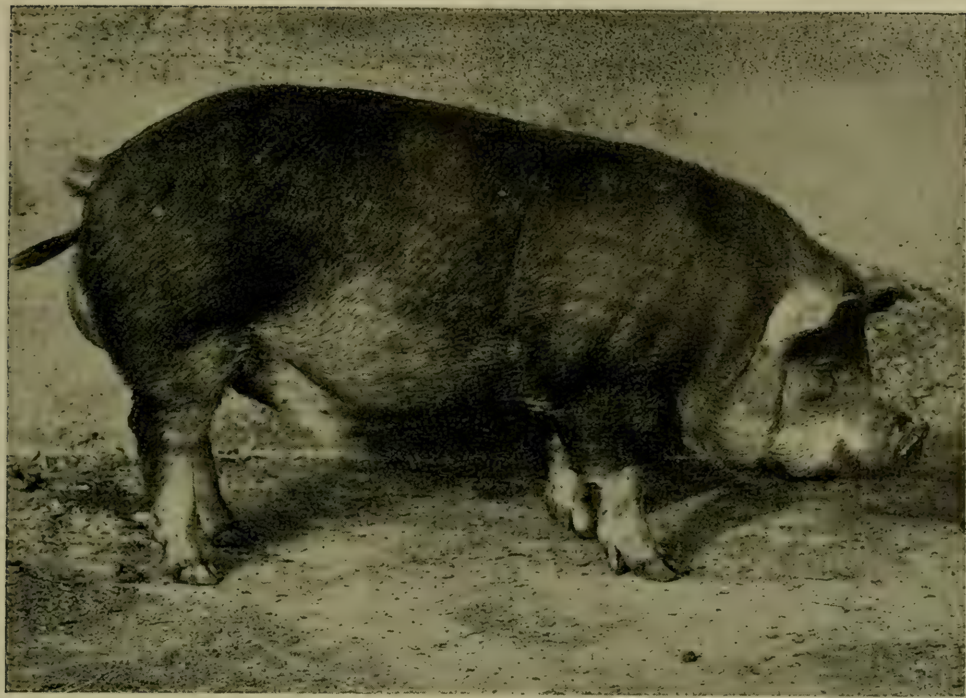
Ten pigs were produced in the F_1 of the Berkshire×Tamworth cross. Eight were red with one or more small black spots and two were self red. The spots were very small and much fewer than in the pigs from the Berkshire×Duroc-Jersey cross. One had but a single black spot and it seems possible that the restriction factors for black are so strong in the Tamworth breed that the two self red pigs are merely somatic variations in the amount of black and not genetically different from their litter mates.

In the Berkshire×Duroc-Jersey cross there were produced an F_1 generation of twenty-nine pigs, an F_2 generation of one hundred fifty-one pigs, a backcross generation (F_1♂ × Duroc♀) of thirty-five pigs, one F_3 litter of eleven pigs, and a litter (F_1♂ × F_2♀) of five pigs. The F_1 pigs were all red with black spots, but the red became lighter in color as they grew older. The colors of the F_2 and backcross pigs are given in Table II.

TABLE II

Color	F_2	Backcross
Black-and-red	47	19
Black-red-and-sandy	10	....
Black-red-and-white	10	1
Black-and-sandy	11	....
Black-sandy-and-white	6	....
Black-and-white	27	....
Self Red	14	14
Red-and-sandy	3	1
Red-and-white	3	....
Self Sandy	7	....
Sandy-and-white	7	....
White	3	....
Totals	148	35

The red and sandy are quite distinct at birth but as the pigs grow older they may become darker or lighter until at maturity almost all shades of red are represented. Taking the classification at birth, it appears that black con-



A RED BOAR OF THE SECOND GENERATION OF BERKSHIRE X DUROC-JERSEY CROSS

This boar was lighter colored on the belly than on its sides. The presence of two shades of red on the same animal was characteristic of nearly one-fourth of the second generation. Compare with the nearly solid black pig shown on the opposite page. (Fig. 16.)

trasted with the absence of black gives a perfect 3 : 1 ratio in F_2 and a close approximation to a 1 : 1 ratio in the backcross. Therefore it seems proven beyond doubt that the Berkshire possesses a single factor for black spots which is absent from the Duroc-Jersey and the Tamworth. The size and

Table III

Description	F_2		Backcross	
	Calculated	Observed	Calculated	Observed
Black-and-red; Black-red-and-sandy; Black-red-and-white	62.4	67	17.5	20
Black-and-sandy; Black-sandy-and-white	20.8	17		
Black-and-white	27.7	27		
Red; Red-and-sandy; Red-and-white	20.8	20	17.5	15
Sandy; Sandy-and-white	13.9	14		
White	2.3	3		
Total	148	148	35	35

A LITTER OF THE SECOND GENERATION SHOWING VARIATION IN SIZE

The second generation was distinctly more variable than the first. (See the graphs in Fig. 19.) This would be expected if there is segregation of growth factors. The weights of these hogs, from left to right, were 221, 293, 90, and 170 pounds (Fig. 17.)

number of the spots is largely determined by modifying factors which must be numerous since no pig in F_2 possessed as much black as a pure bred Berkshire, although one had about ninety-five per cent as much. Those which have red color upon them as contrasted with those which have no darker shade of red than sandy, constitute almost exactly nine-sixteenths of F_2 and fully 100% of the backcross. Therefore it is reasonably clear that the Duroc-Jersey possesses two factors, absent in the Berkshire, which are both necessary for the production of red. If we assume that either factor by itself produces some shade of sandy, everything is satisfactorily explained except that the pigs carrying black have a much higher proportion of those which lack both red and sandy than do the pigs which do not possess the black. If we assume a factor linked to black which can dilute to white the sandy produced by one of the factors for red when the other factor for red is absent, the actual results are very close to the theoretical ones. This is shown in Table III.

The author has no theory to account for the presence of two shades of red on the same animal. The fact that these "bicolor reds" constituted almost exactly one-fourth of the F_2 generation seems to point to a simple explanation, but there were three easily distinguishable types of this bicolor character, as follows: first, roaning, of which the genetic foundation is not known; second, small irregular spots of red, usually around the face, particularly on the eyelids, while the rest of the animal was some lighter color; and third, a lighter colored belly than sides or back. This last feature is always found as an integral part of the agouti pattern where that occurs among other mammals and seems to be connected with that pattern here also, for it is very prominent on the young of the wild hog, and when an F_2 boar which was red with a sandy belly was mated to an F_2 sow (both from the Berkshire × Duroc-Jersey cross), which was white but had

A LITTER OF THE THIRD GENERATION (BERKSHIRE X DUROC-JERSEY CROSS)

Showing striped pigs with lighter colored bellies. This striping is a curious atavistic recurrence of an ancestral trait present in the wild boar but not in the domestic breeds. The recurrence here is doubtless due to a recombination of Mendelian factors. (Fig. 18.)

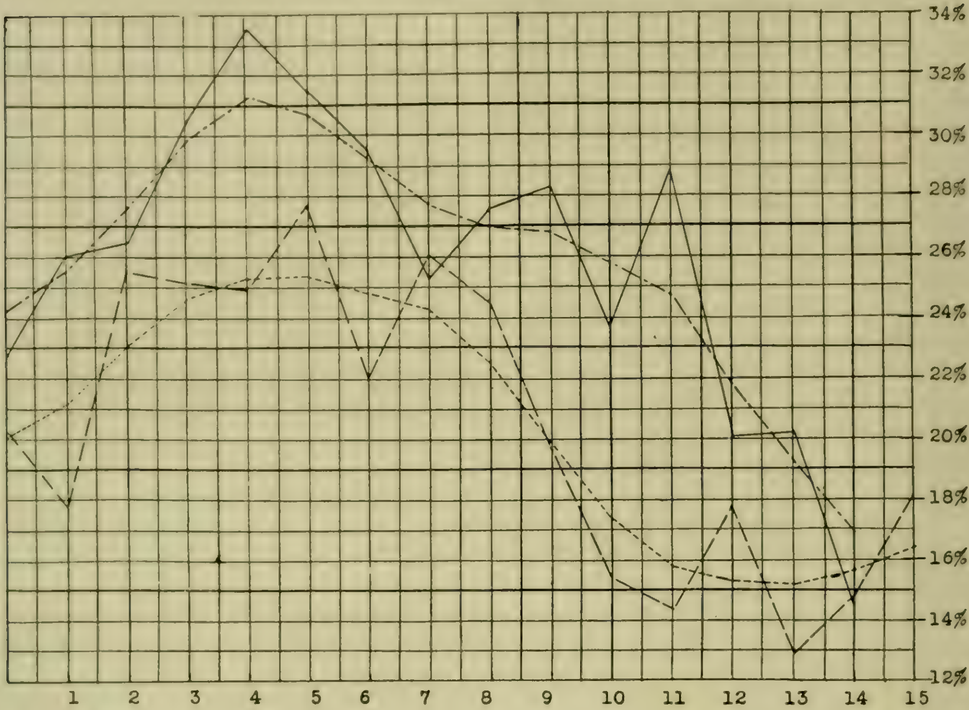
black pigment patches in her skin, there resulted an F_3 litter of eleven pigs *every one of which* had a lighter belly than back and was striped in a fashion similar to that of the young of the wild boar but differing from the latter in the shade of the contrasting stripes. They were not uniform in shade themselves. This type of "reversion" in swine has been reported frequently, but the remarkable fact that so large a litter as this should so uniformly show both the lighter belly and the striping pattern makes it seem certain that the factorial basis for this "reversion" is simple, and that both lighter belly and striping are produced by almost identical factor complexes. Two individuals of the F_2 generation showed stripes similar in pattern but very faint.

DIFFERENCES IN GROWTH

The economic importance of some definite knowledge in regard to factors for rapid growth may be surmised from the extent of the practice of cross-breeding hogs in order to secure the greater size and vigor of the F_1 hogs for market purposes. The Berkshire × Duroc-Jersey cross was extensive enough to furnish significant data upon this point. Since they were not all born at the same season nor in the same year it is obvious that they were not all exposed to identical weather conditions nor fed rations as identical as would be desirable in a nutrition experiment. However it was the aim always to feed the best possible ration to produce the maximum practical gains and it is believed that the data are, on the whole, reasonably comparable. The pigs were weighed at birth and at monthly intervals afterward and the coefficients of variation of the weights of the F_1 individuals for each month were figured separately from those of the F_2 individuals. The resulting curves are shown in the accompanying figure.

The outstanding fact of genetic importance is that the variability of the F_2 generation is distinctly greater than that of the F_1. That, to be sure, is

The Coefficients of Variability for the Monthly Weights of the F_1 and F_2 Generations of the Berkshire X Duroc-Jersey Cross



Age in Months

— — — — — Graph of the coefficient of variability of the F_1 generation.
----------------- Smoothed curve for the C. V. of F_1.
————————— Graph of the coefficients of variability of the F_2 generation.
— - — - — - — Smoothed curve for the C. V. of F_2. (Fig. 19.)

what was to be expected from the genetic standpoint and it is in agreement with the experience of practical breeders. It is definite proof of two things: First, that some of the factors which have the power to stimulate growth are not identical in the Duroc-Jersey and the Berkshire breeds; second, that there is some degree of homozygosis for these growth-stimulating factors within the limits of each breed.

To what extent being purebred from the standpoint of the breed registry society indicates homozygosis for these factors; whether the number of factors involved can be determined; whether the differences in growth indicate differences in the identity of these factors or merely differences in the combinations; and whether these factors are so linked in groups as to make recombination of the desirable ones impossible or at least impracticable; these are all interesting questions which these data raise but are too meager to answer.

Other interesting questions, not primarily genetic, relate to the shape of the curve. The maximum variability seems to be reached at or shortly following weaning time and coincides with the period of the lowest mortality. Does this mean that the best time to select breeding stock for size and early maturity is when they are from three to six months old? Of course it was impractical to keep the hogs which were not desired for breeding purposes until they were two or three years old and therefore the question is still left open as to whether the hogs finally would not have become more uniform in size; that is, whether the differences were in potential size or in earliness of maturity.

Figure 17 is a photograph of one of the F_2 litters most extreme in its range of variation in growthiness. These four individuals had received identical treatment and none of them had ever been noticed to be sick, yet when this picture was taken when they were being marketed at the age of eleven months the weights were, from left to right: 221, 293, 90, and 170 lbs.! Possibly more animals are born runts than is commonly believed.

CONCLUSION

It is not believed that all the hypotheses which have been tentatively advanced in this article will stand in every detail without amendment the test of further research. However some of them will and if the others awaken enough interest to stimulate further research with this economically important animal, they will have served a useful purpose.

POSTSCRIPT

Since the above was written a report[7] of the results of a cross between mule-foot and Duroc-Jersey swine has been published which agrees closely with two of the main conclusions reached in this experiment: Namely, that the presence of black as contrasted to its absence is dependent upon a single factor and that the different shades of red are due to the interaction of a few independent factors which do not affect black. The black of the mule-foot swine behaves like that of the American Hampshire but whether the two are genetically identical is still undetermined.

Castle's Book Revised

Genetics and Eugenics: A Textbook for Students of Biology and a Reference Book for Animal and Plant Breeders, by W. E. Castle, Professor of Zoology in Harvard University and Research Associate of the Carnegie Institution of Washington. Harvard University Press 1920. 395 pages, 154 figures.

Its clearness and pleasing style as well as its thoroughness of treatment have made Professor Castle's "Genetics and Eugenics" one of the most extensively used books on its subject since its appearance in 1916. In the second edition, which has recently appeared, several chapters have been rewritten and the total length has been increased by 42 pages in order to take account of the rapid progress of our knowledge. The subjects of linkage and the nature of genetic change are dealt with at considerably greater length.

The greatest change in viewpoint is with respect to the hereditary basis of fluctuating variation. In his earlier work, Professor Castle assumed that adult characteristics depend on relatively few mendelizing unit factors, and accounted for his success in bringing about great changes, by means of long continued selection of minute variations, by holding that the hereditary factors are themselves subject to fluctuating variation. His own experiments, however, as well as others, stimulated to a large extent by his championship of the above view, have now demonstrated beyond question the remarkably high degree of constancy of most Mendelian factors, and have made it clear that each characteristic is in general affected by many factors. Fluctuating variation is thus interpreted in the present edition as depending largely on the recombinations possible in a system of many unit factors, each insignificant in its own effects, and to a much less extent upon mutation of the units themselves.

Taken as a whole, the book can be heartily recommended as giving a reliable and very readable account of the present state of knowledge of genetics together with a sane discussion of the application to eugenics.—S. W.

[7] Detlefsen, J. A. and Carmichael, W. J. Inheritance of Syndactylism, Black, and Dilution in Swine. Journal of Agricultural Research, Vol. 20, pp. 595-604.

ORIGIN AND DEVELOPMENT OF THE NERVOUS SYSTEM[1]

A Review

SEWALL WRIGHT
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THE subject of Professor Child's latest book is of wider interest than might be thought from the title, dealing as it does with some of the most fundamental problems in biology.

THREE FUNDAMENTAL PROBLEMS

The means by which the parts of an organism are coordinated, making it an individual, instead of merely a mass of living matter, is one of these problems. Three modes of interaction between parts of the body are recognized: mechanical stress, transportation of internal secretions in a circulatory system, and transmission of stimuli directly through the protoplasm as in the nervous system of animals. In spite of the great emphasis which recent discoveries have placed on the regulatory action of internal secretions, most biologists will doubtless agree with Child in considering the nervous system as the most important source of internal coordination, as it undoubtedly is of external adaptation.

No less fundamental is the problem as to the agency which controls the course of development. The orderly series of processes—cell divisions, formation of cell layers, formation of organs by differential growth and complicated foldings, qualitative differentiation into epithelium, nerve, muscle, gland, bone, etc., all in proper functional relations—through which, in the course of a few weeks, a single, apparently rather simple, microscopical cell converts itself into a highly complex multicellular organism, has been the despair of those who have attempted to explain life phenomena in terms of physics and chemistry.

DEVELOPMENT IN RESPONSE TO EXTERNAL STIMULI

Child emphatically rejects the extreme preformist view, under which development consists in the growth and assembling of parts already represented in the egg cell by determiners, and takes place without regard to external conditions so long as the latter are not incompatible with life. He finds the coordinating agency of development in the same property of living protoplasm of transmitting stimuli which finds its highest development in nerve cells. Development, under this view, is ultimately a reaction to external stimuli.

The action of a stimulus on the egg cell sets up a temporary excitation-transmission pattern. Excitation means higher metabolism, a higher rate of living. The excitation-transmission pattern thus means a metabolic gradient in the egg. Owing to differential behavior of the protoplasm at different rates of metabolism, the prevailing excitation-transmission pattern tends to be accompanied by material differentiation, such as holds between the yolk-laden, slowly dividing vegetative pole, and the yolk-free, actively dividing animal pole of the egg. This primary "organismic pattern" may have symmetry of various sorts; spherical, simple axial, or bilateral, depending on the pattern of action of the external stimuli, which reach the egg. As cell division proceeds, coordination is maintained by continuance of the primary metabolic gradient, now to some extent independent of the continued play of external stimuli, owing to the material differentiation at different levels. The general plan of the

[1] *The Origin and Development of the Nervous System*, by Charles Manning Child, Professor of Zoology University of Chicago. The University of Chicago Press 1921. 296 pages with 70 figures. Price $1.90 postpaid.

developing organism is determined by the type of symmetry in the gradient pattern.

COMPLEXITY IN DEVELOPMENT

As the hereditary potentialities of all cells of a given organism are believed to remain the same, it may seem difficult to understand how a merely quantitative gradient can bring out the complexity of structure and the qualitative differentiation of tissues, which make their appearance. The hereditary constitution, however, is necessarily complex. Different elements in it may prevail at different rates of metabolism. Moreover, the gradient pattern while continuous is ever changing. The past history of cells is thus a factor limiting their later development, in addition to genetic constitution, position in the gradient pattern of the organism at the given time, and direct external stimuli.

The original axis of highest activity, in general, maintains its dominance over the lower levels in the gradient and tends to become even more specialized in the transmission of stimuli in animals in which the hereditary potentiality for such specialization is present. Thus the region of first active growth in the arthropod egg becomes the ventral nerve chain and the similar region in vertebrates becomes the medullary plate and ultimately the brain and spinal cord.

In case a secondary center of activity becomes sufficiently isolated from the primary center, a second individual tends to be formed about it. Separate individuals may result as in the asexual reproduction of many lower vertebrates or a system with mechanical continuity and perhaps transportative coordination, between parts, but only slight integration in behavior may result as in plants, hydroids, tapeworms, etc. Finally through a secondary reattainment of dominance by the primary center, a segmental organism may be produced as is suggested for annelids, anthropods and vertebrates.

THE SCOPE OF THE BOOK

This, in a rough way, may bring out Professor Child's theory of development to which the greater part of this book is devoted. Considerable attention is devoted to the nature of stimulation and transmission, to evidences for the existence of metabolic gradients in particular organisms, and to applications of the theory to special problems such as the development of the pattern of nerve cells and of the nervous system as a whole. Suggestive analogies with phases in the organization of human societies are frequently presented.

RELATION TO VITALISM

The theory, as a mechanistic one, seems the very antithesis of such views as those set forth by Driesch with his quasi intellectual factor, the entelechy, as the guiding spirit of development, and by Bergsen with his elan vital. In a sense, however, there is a curious approach. Under Child's theory there is complete continuity from the reaction of the cell with its environment which constitutes the primary metabolic gradient, and from the later reactions by which the pattern of the developing embryo is laid down in accordance with the changing gradient pattern, to the intellectual processes by which the adult organism adjusts its relations to the outside world. Since awareness is certainly associated with the dominating nervous activities in the latter case, it seems necessary to grant the possibility of its presence in the former, unless we wish to assume that it is arbitrarily superimposed upon metabolic gradients at a certain level of complexity. Moreover as a state of consciousness in the higher case is certainly closer to reality than any impressions which it may make on other consciousnesses, the question at least seems open as to whether the entelechy may not be the reality of which the metabolic gradient, however much correlated with environmental factors, is merely the outward show.

However this may be, it does not, of course detract at all from the vastly greater significance to science of such a conception as that which Child presents.

RELATION OF GENETICS

From the standpoint of the geneticist it is to be regretted that the author has made no attempt to bring the facts of genetics into relation with his theory.

The geneticist, to some extent, is able to deduce the nature of details in cell organization from observed differences among adults at the very opposite end of the developmental series. He finds an enormous number of cases in which differences in adult characteristics are inherited in such a way as to make it necessary to believe that they depend on differences in real units of the cell organization. These units can be handed on for an indefinite number of generations, in association with the most varied collections of other units, without suffering change. If absent, they can not be reconstituted by the cell. They must divide as a rule with the most perfect equality at each cell division. They must, in short, be veritable organic individuals, though merely of molecular dimensions, living in the cell, and reproducing by fission at each cell division.

Geneticists have not only learned much about the nature of these entities in the cell, but find a great deal of evidence as to just where they live. They are transmitted in inheritance as if each were located in a definite place in one of a definite number of separate chains. Evidence of the most direct kind indicates that these chains, deduced from breeding experiments, are none other than the chromosomes actually visible in the cell nucleus.

Geneticists, moreover, have discovered the fact, rather embarrassing to an extreme preformation viewpoint, that there is no relation between the arrangement of these units in the cell, and the kind of characteristic of the adult in which their absence or modification results in visible change. In the fruit fly for example, factors which seem to affect only eye color are found to be scattered at random among the different chromosomes and the same is true of factors which seem to affect only eye shape, wing venation, body color or bristles. In some cases moreover, a single hereditary unit is responsible for differences in apparently unrelated parts of the body.

With all of this knowledge of the ultra-microscopic constitution of the cell, and of the one to one relations between cell units and differences in adult characteristics, the geneticist can as yet say little as to how the unit factors determine the course of development. His scheme lacks motion. Some such conception as that of Child is needed to show how one system gives rise to the other. Child's theory on the other hand must take account of the details of heredity if it is to get beyond the vagueness which leaves it rather obscure as to why one egg develops into a cabbage, another into a man with brown eyes and another into a man with blue eyes.

The location of unit factors in the chromosomes, indeed their very existence, is, however, dismissed by the author as an extreme and impossible preformist view. He apparently looks on the cell as an organization in a particular kind of matter, determined merely by a surface-interior gradient in relation to external conditions. This view overlooks the great body of cytological evidence which indicates that each of the chromosomes and, indeed, each of the granules visible along the chromosomes in the thin thread stage, is a self perpetuating individual, as well as the genetic evidence for the individuality of the unit factors, referred to above.

COMPATIBILITY OF SIMPLE MECHANISMS OF HEREDITY, AND DEVELOPMENT WITH A COMPLEX CELL ORGANIZATION

To the reviewer, however, the genetical and cytological conception of the cell, as an association of independent organisms, living in a relatively large,

less specialized mass of protoplasm and controlling the behavior of the whole in response of course to external stimuli, is not at all incompatible with a simple mechanism of heredity and a simple physiological conception of development such as that offered by Child. It is, of course, impossible to assume that the genetic basis of the differences among the millions of species of animals and plants, and the millions of individuals within each species can be very simple. It must be remembered, however, that a given cell complex has not developed out of nothing in the course of a few weeks, as the individual seems to do. It is the result of millions of years of uninterrupted slow change. The problem of heredity is merely to explain the lack of interruption in this history, i.e. the persistence of the complicated cell organization through cell division and fertilization. The mechanisms by which all of the essential entities within the cell are caused to reproduce by simultaneous fission (mitosis) and under other conditions to conjugate in pairs (synapsis) need not be very complex.

As to individual development, there seems to be no incompatibility with Child's explanation of its course as the behavior pattern of a particular kind of cell in relation to the metabolic gradient determined ultimately by the environment. The hypothesis that the activities of the different unit factors vary at different rates according to the position of the cell in the gradient pattern of the developing organism and to the specialization which the cell has already undergone as a result of its past history, thus determining the details of the "organismic pattern," in reaction of course with the environment, seems a necessary supplement to Child's highly suggestive hypothesis.

Fewer Births in United States

Births in the registration area (comprising about 58% of the total population) of the United States in 1919, recently compiled by the Census Bureau, show a slight decrease for the first time. This is presumably a consequence of the war, and the absence from home of a considerable part of the male population.

In the birth registration area exclusive of Rhode Island, which failed to send in transcripts of birth certificates, 1,365,585 infants were born alive in 1919. The total number of deaths in the same area was 791,732, the births exceeding the deaths by 573,853, or 72.5 per cent.

The number of births for the year 1919 compared with 1918 shows a decrease of 7 per cent in the registration area. Each state shows a decrease, the per cent ranging from less than one in Maryland to ten in Utah and Wisconsin. This is in marked contrast to previous years as the number of births had increased from year to year.

The infant mortality rate (number of deaths of infants under 1 year of age per 1,000 born alive) is 87 in 1919 and is the lowest infant mortality rate on record in the birth registration area. Among the states these rates range from 63 in Oregon and Washington to 113 in South Carolina.

The Social Hygiene Movement

SANITY IN SEX, by William J. Fielding. Pp. 333. New York, Dodd, Mead and Co., 1920.

Mr. Fielding presents a survey of the sex-education movement of recent years, particularly that which was an outgrowth of attempts to protect the health and morale of the armed forces during the war. He gives one of the best popular accounts available of the social hygiene work of this period. His chapters dealing with birth-control and psycho-analysis are less adequate, and none too well founded, biologically.—P. P.

HERITABLE CHARACTERS OF MAIZE

VII. SHRUNKEN ENDOSPERM[1]

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IN 1914 Professor R. A. Emerson received from Dr. M. R. Gilmore of the Nebraska Historical Society several small packages of maize seeds which the latter had collected the previous year from gardens of the Ponka Indians on the Niobrara reservation in Nebraska. Among these packages was one containing starchy and sugary, white, red, and purple, and self-colored and speckled kernels, all of which had been taken from a single ear. These seeds were planted at the Nebraska Experiment Station by Dr. Emerson and a number of the resulting plants self-pollinated. On one such self-pollinated ear in this pedigree there appeared among the starchy kernels certain ones with an unusual type of indentation. The kernels of flour corn ordinarily are not indented at all but are smooth and rounded in shape like flint corn. The starchy kernels on this ear were floury in texture and most of them smooth and rounded. Some, however, were deeply indented at the top with a smooth crease or, in the case of broad and thick kernels, with a deep dimple. Others were indented not at the top but on the sides, as if in drying the endosperm had shrunken and the sides of the kernel had fallen in. Still others were indented at both the top and sides which gave them a shrunken and pinched appearance. When these unusually shaped seeds were planted and the resulting plants selfed, they were found to breed true for this character and subsequent tests have shown it to be inherited as a simple recessive to the normal or full endosperm. It has been called "shrunken" and is designated by the genetic symbol *sh*, the dominant allelomorph of which is *Sh*.

In 1918 shrunken was crossed with a number of other types of maize to determine its relation with other known genetic factors. Subsequently, thru the kindness of Dr. Emerson, all of this material came into possession of the writer.

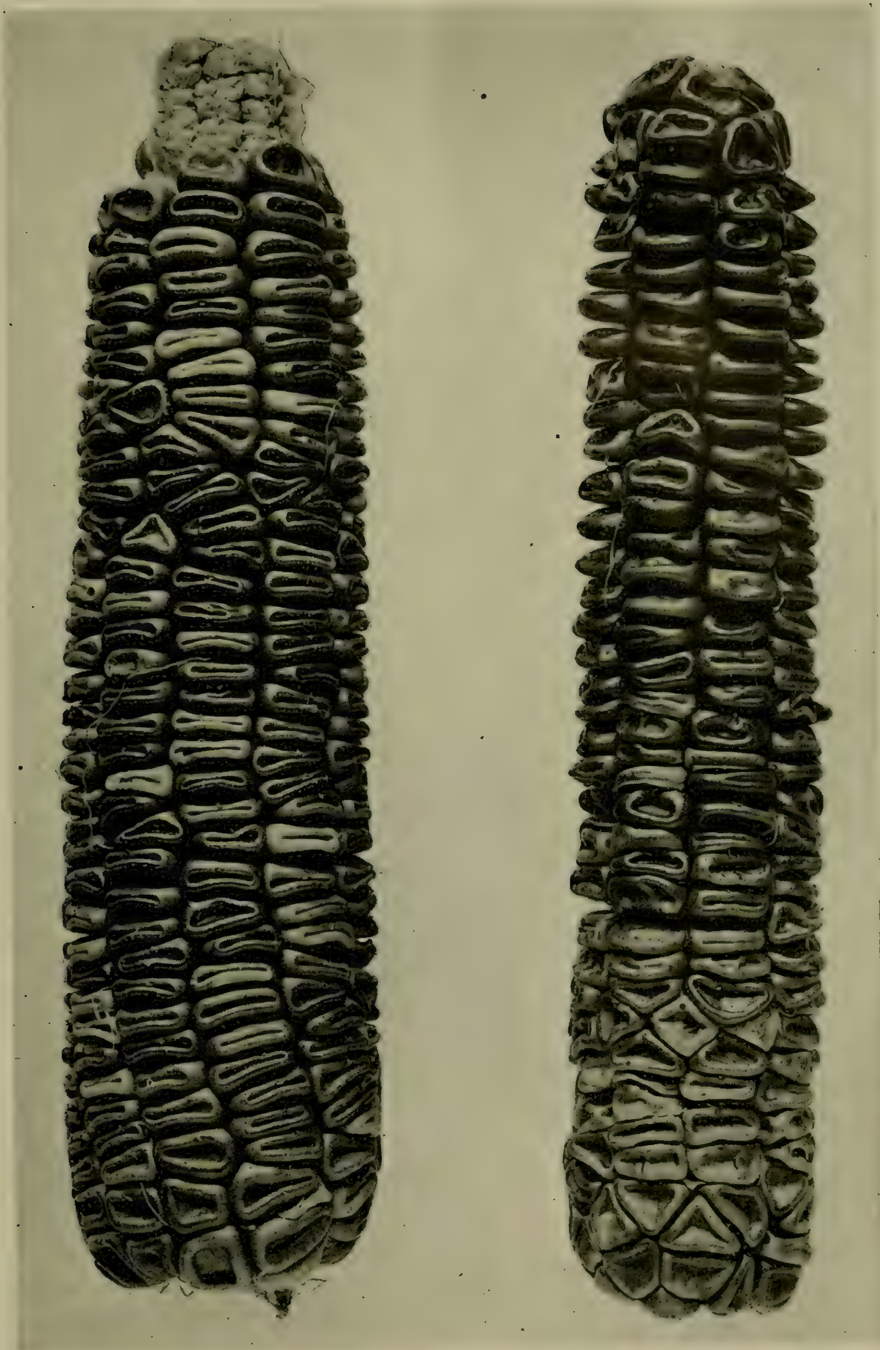
DESCRIPTION OF SHRUNKEN ENDOSPERM

An adequate conception of the nature and general appearance of shrunken kernels may best be had from examination of the accompanying illustrations. In Figure 20 two selfed ears from homozygous shrunken plants are shown and in Figures 21 and 22 ears containing both shrunken and non-shrunken kernels in approximately equal numbers. The latter ears are the result of pollinating plants heterozygous for the factor for shrunken with pollen from homozygous shrunken plants. Figures 23 and 24 show different views of shrunken and non-shrunken kernels taken from the same ear.

It will be noted from Figures 21 and 22 that where the rows are straight and the kernels fairly uniform, especially in the middle portion of the ear, shrunken kernels are usually more flat, somewhat broader, and frequently shallower than non-shrunken ones. In such kernels the top is usually folded in to form a deep and smooth crease altho at times the indentation is from the sides of the kernel giving them a pinched appearance and leaving considerable space between the kernels at the top. On the butt or tip of the ear where the kernels normally are irregular in shape, or where adjoining kernels fail to develop, shrunken kernels are characterized by a deep, broad and rounded dimple.

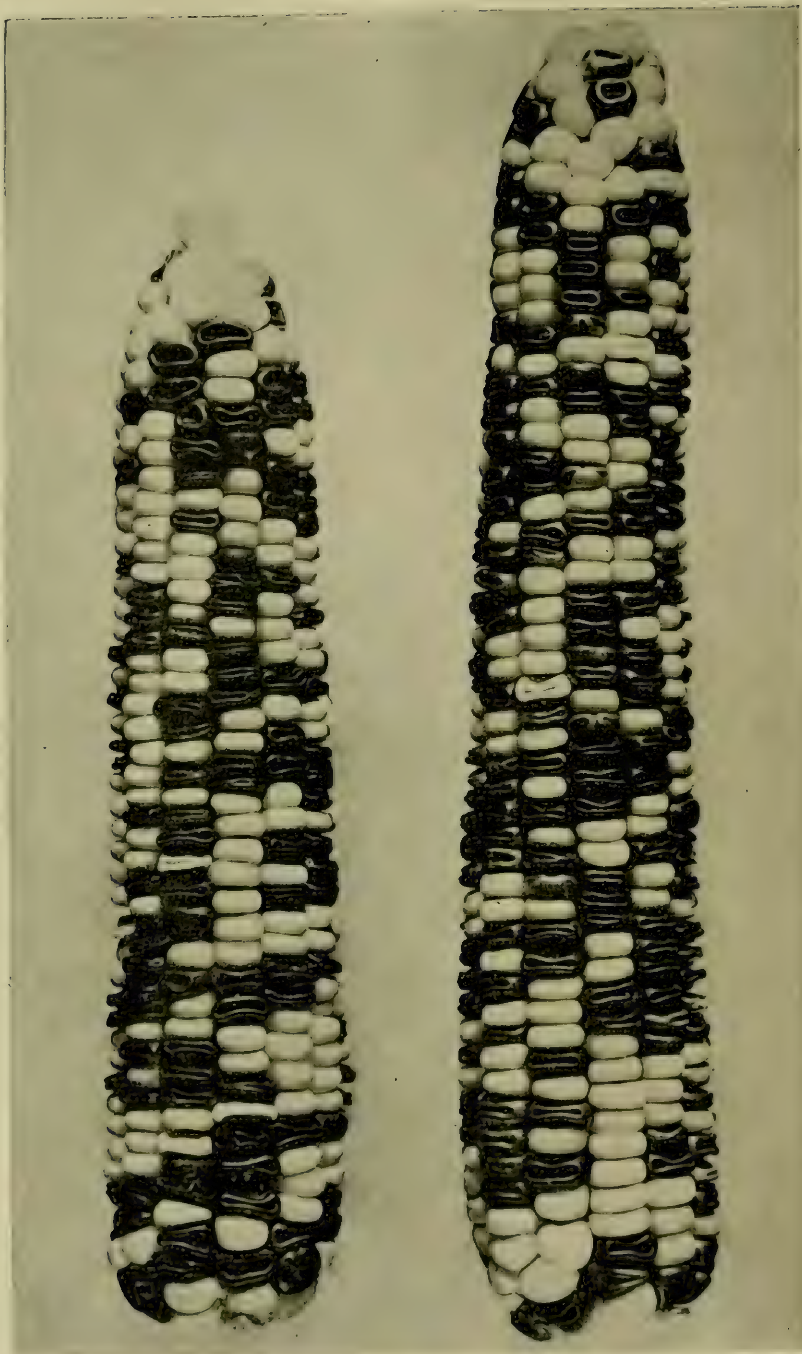
The shrunken indentation is sometimes not unlike the creased or rounded dimple found in ears of a flinty type of dent corn—particularly on the butt

[1] Paper No. 87, Department of Plant Breeding, Cornell University, Ithaca, New York. Photographs by W. I. Fisher.



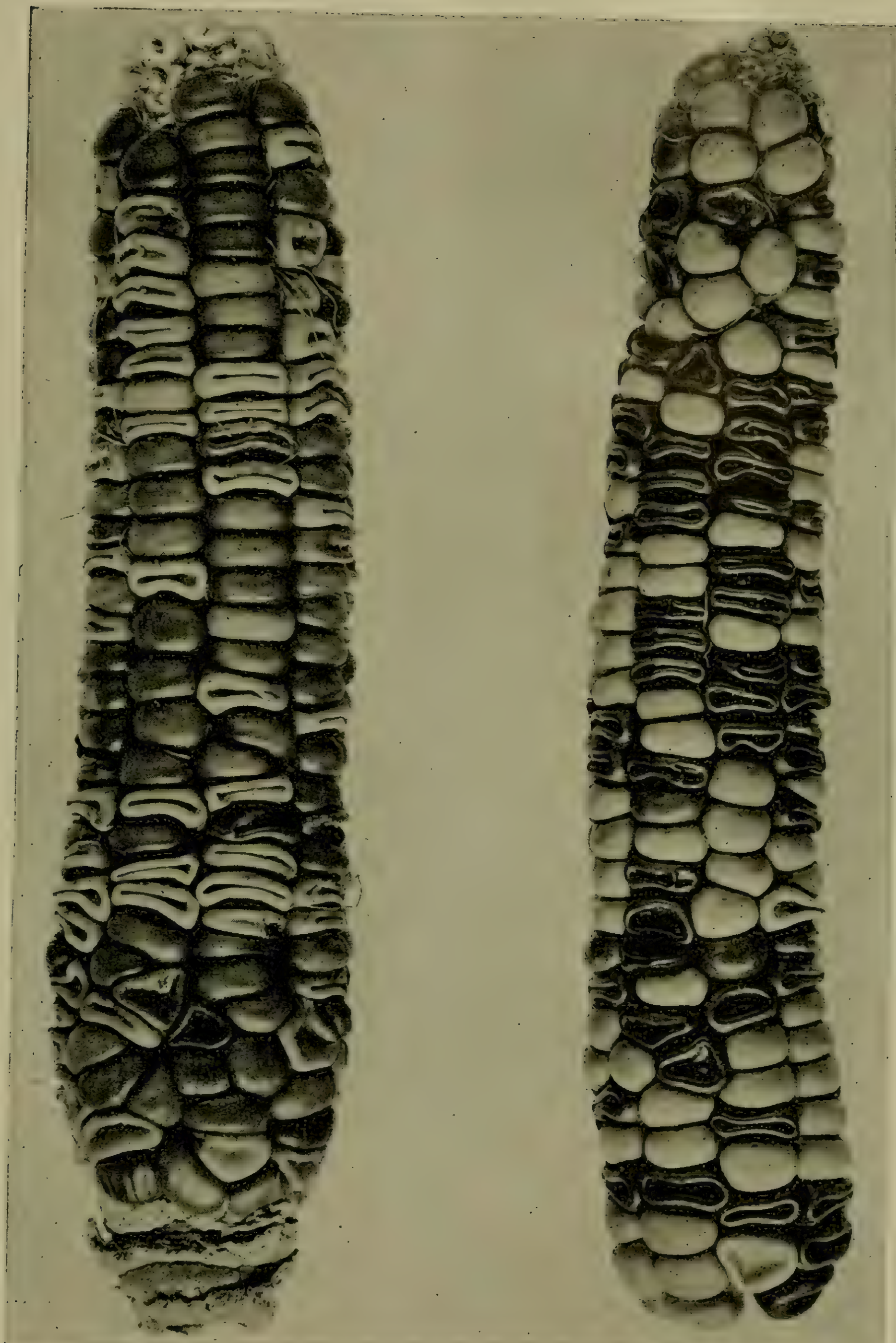
SHRUNKEN KERNEL MAIZE EARS BRED FROM PONKA INDIAN CORN

Among some maize seeds obtained from the Ponka Indians of Nebraska in 1914 were some that were deeply indented at the top and some indented on the sides, as though the endosperm had shrunken causing the sides to fall in. When these seeds were planted they were found to breed true, and subsequent tests have shown this condition to be inherited. (Fig. 20.)



EARS WITH BOTH SHRUNKEN AND NON-SHRUNKEN KERNELS

One of the parents of this hybrid had colored seeds with shrunken endosperm, and the other had white seeds which were not shrunken. These hybrid ears show that the parental combinations tend to reappear, that is most of the colored seeds are shrunken while the colorless ones are not. (Fig. 21.)



SHOWING SHRUNKEN ENDOSPERM IN BOTH WHITE AND COLORED SEEDS

The kernels on these ears show linkage of the shrunken endosperm character with two different aleurone characters. (Aleurone is the thin external layer of the kernel containing the color character.) The ear at the left is the result of crossing a hybrid plant with one that was pure for colorless aleurone and non-shrunken endosperm. In this instance one of the parents of the hybrid was white and shrunken and the other was colored and not shrunken. Again the parental combinations reappear, most of the white seeds being shrunken and the colored ones not. In the ear at the right the parent of the hybrid with non-shrunken endosperm also had white aleurone. Note that very few of the white seeds are shrunken, showing that this aleurone factor also is linked with the new character, shrunken endosperm. (Fig. 22.)

and tip kernels. Usually, however, the dimple or crease is much more pronounced than in ordinary dent corn. The shrinking from the sides of the kernel presents a condition which the writer has never observed in dent corn, the indentation of which is usually rough and always at the top. The most striking difference in the two types of indentation aside from one of degree is the fact that in shrunken kernels a cavity is usually found within the upper part of the endosperm as if the cells in this region had not been filled with starch as the kernel matured (See Figure 24.) Previous to the hard dough stage shrunken kernels are smooth and rounded in outline. As they begin to dry the top or sides sink in to such an extent at times that the cavity is closed altho its outline may be distinctly seen. In other cases, particularly where there is a fairly thick layer of corneous starch at the top of the kernel the latter may be almost smooth in outline. In such kernels the cavity beneath the shell of corneous starch is very pronounced. On the other hand, in dent corn the endosperm is filled, the indentation being due to a greater shrinking of the soft starch at the top of the kernel than of the corneous starch on the sides.

By reason of this fact, little difficulty has been found in distinguishing shrunken from non-shrunken kernels with starchy endosperm. It is difficult, however, always to classify shrunken and non-shrunken kernels in sweet corn, particularly on ears of the Country Gentlemen type where the kernels are long, narrow and pointed and very irregular in shape. Such separations are much more readily made on eight or ten rowed ears of sweet corn where the kernels are broad and rounded and fairly regular in outline.

In examining shrunken and non-shrunken kernels one is apt to gain the impression that the former are lighter in weight than the latter since they are apparently not fully developed. This, however, is not the case. Data obtained by weighing the shrunken and non-shrunken kernels on the ears from six F_1 plants that had been backcrossed to shrunken show that while the non-shrunken kernels are slightly heavier the difference is not statistically significant. These data are given in the following table:

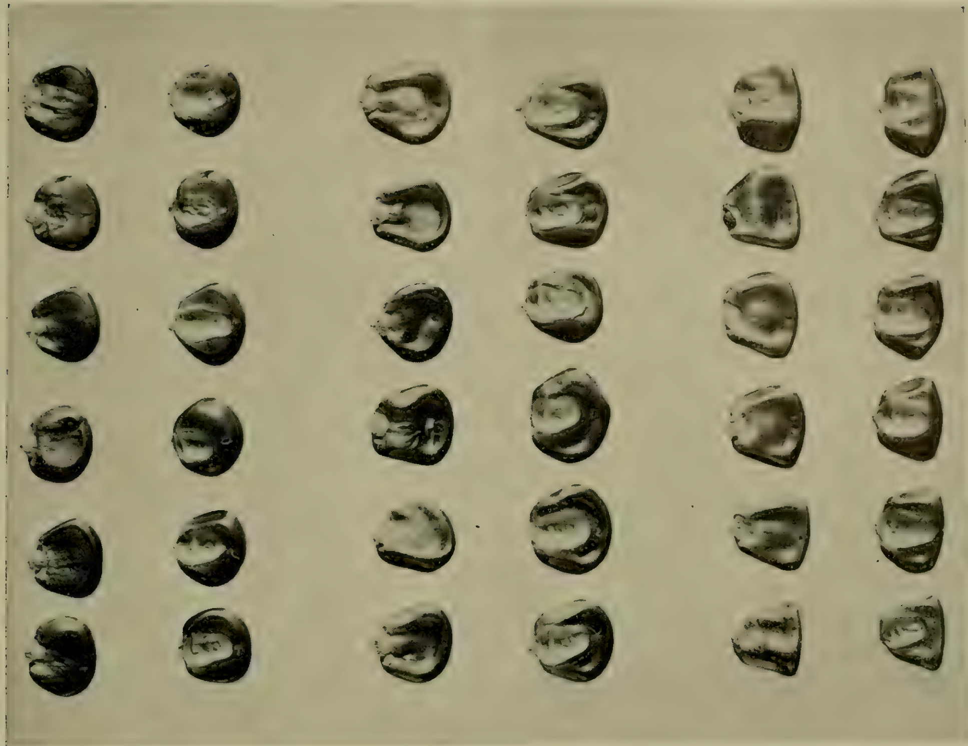
	Number of kernels weighed	*Average weight of kernels*
Non-shrunken	914	272 ± 8.42 mg.
Shrunken	874	259 ± 10.89 mg.
Difference		13 ± 13.76 mg.

INHERITANCE OF SHRUNKEN ENDOSPERM

As stated above the character shrunken endosperm is inherited as a simple recessive to the normal or non-shrunken. Numerous crosses have been made between shrunken and non-shrunken plants and the F_1 seeds produced have been normal in all cases. A number of such hybrid kernels have been planted and the resulting plants selfed for F_2 progenies. Two such progenies consisted of 705 non-shrunken and 239 shrunken kernels. This is a deviation of only 3 ± 8.97 seeds from the 3: 1 relation expected when the parents differ in a single pair of factors. A number of F_1 plants also were backcrossed with the recessive shrunken in connection with some linkage studies to be described later. A total of 20,556 kernels resulting from such backcrosses have been examined, of which 10,295 were shrunken and 10,261 non-shrunken. This is a deviation of only 17 ± 48.3 seeds from the 1 : 1 ratio expected. Evidently shrunken endosperm is differentiated from the normal by the single factor pair *Sh sh*.

LINKAGE RELATIONS OF *Sh sh* AND *Wx wx*, AND *Sh sh* AND THE ALEURONE FACTORS *C c* AND *I i*

The fact that waxy endosperm and aleurone color in maize are linked was first established by Collins and Kempton (1911). Bregger (1918) was able to show that the particular aleurone color factor concerned is the *C c* pair. Among the crosses made by Dr. Emerson in 1918 with shrunken one involved



LATERAL VIEWS OF SHRUNKEN AND NON-SHRUNKEN KERNELS FROM A SINGLE EAR

The two rows at the left are non-shrunken kernels; in the middle two rows the indentation is from the sides of the kernels, and in the two rows at the right the indentation has taken the form of a deep crease. The latter character is shown better in the kernels in the centre of Fig. 24. (Fig. 23.)

the *C c* and *Sh sh* factor pairs. A homozygous red aleurone shrunken plant of the genetic constitution *C C sh sh* was crossed with a colorless aleurone non-shrunken plant of the constitution *c c Sh Sh*. An F_1 plant of this cross, grown in the greenhouse during the winter of 1918–19, was selfed giving a small F_2 progeny. On this ear shrunken and non-shrunken kernels were found as well as colored and colorless but all of the shrunken kernels were also colored. This clearly indicated that the *Sh sh* and *C c* factor pairs are linked. To definitely establish the fact the writer in 1919 made a number of backcrosses between F_1 plants and the double recessive. Twenty-eight such backcrossed ears gave progenies totaling 8,326 kernels distributed as follows:

Colored non-shrunken	Colored shrunken	Colorless non-shrunken	Colorless shrunken
136	3,992	4,049	148

The parental combinations of the characters concerned in this cross are in great excess, there being 8,041 kernels of these combinations and only 284 of the other two. This is very far from equality which is expected with independent inheritance. It is evident that the factor pair *Sh sh* belongs to the same linkage group as *C c* and *Wx wx*, with a crossover percentage in this case of approximately 3.4 for *Sh sh* and *C c*. In Figure 21 two such backcrossed ears are illustrated. It will be noted that most of the colored kernels are shrunken and most of the colorless ones are smooth. A few kernels of the opposite combinations, however, are to be found on each of these ears.

The ear on the left in Figure 22 illustrates the coupling series of these two factor pairs. In this case the parental combinations were *C Sh* and *c sh*. This ear is the result of pollinating an F_1

CROWN AND EDGE VIEWS OF NORMAL AND ABNORMAL KERNELS

The first two rows at the left show kernels in which the endosperm is completely developed. Those in the third row are cut in cross-section to show the cavities which are often found in the upper part of shrunken kernels. The 4th, 5th and 6th rows show the variation in the size and shape of shrunken kernels. In the last row at the right the kernels are cut to expose the cavities in the upper part of the endosperm. (Fig. 24.)

plant of the genetic constitution $\frac{C\ Sh}{c\ sh}$ by the double recessive $\frac{c\ sh}{c\ sh}$. Again it will be noted that while most of the colored kernels are smooth and most of the colorless ones shrunken a few kernels show the opposite combinations of these characters.

To determine the linkage relation of shrunken and waxy a non-shrunken waxy plant of the genetic constitution *Sh Sh wx wx* was crossed with a shrunken starchy plant of the constitution *sh sh Wx Wx*. Several F_1 plants of this cross were backcrossed to double recessive shrunken waxy plants. Twelve ears were obtained from these pollinations containing a total of 2,105 kernels which were distributed among the four possible classes as follows:

Non-shrunken starchy	Non-shrunken waxy	Shrunken starchy	Shrunken waxy
229	813	833	230

Here the parental combinations of the two factor pairs concerned total 1,646 and the new combinations 459. The crossover percentage for *Sh sh* and *Wx wx* in these particular crosses is 21.8.

On the basis of these data the probable order of the three genes in this linkage group is

C	Sh	Wx
c	sh	wx
O	3.4	25.2

It must be remembered, however, that the percentage of crossing-over is variable and that the order of the genes can definitely be determined only in backcrosses where all three pairs of factors are involved at once. Material

is now available for making this three point test.

Shrunken has also been crossed with another aleurone factor *I i*, the existence of which was first established by East and Hayes (1911). The interaction of the recessive allelomorph *i* of this factor pair with the dominant allelomorphs of three other factor pairs *A a*, *C c* and *R r* is necessary for the development of aleurone color (Emerson, 1918). When the dominant allelomorph *I* is present no color develops. A homozygous red aleurone shrunken plant with the constitution *i i sh sh* was crossed with a homozygous non-shrunken plant which was also homozygous for *I* and, therefore, had colorless aleurone. Its genetic constitution for the factors in question was *I I Sh Sh*. The immediate kernels produced were colorless and non-shrunken. Several F_1 plants produced by these kernels were backcrossed to the double recessive. Twenty-eight backcrossed ears were obtained with a total of 7,294 kernels. All four combinations of the characters in question appeared among these kernels, the numbers in each class being as follows:

Colored non-shrunken	Colored shrunken	Colorless non-shrunken	Colorless shrunken
134	3,509	3,525	126

The parental combinations here total 7,034 while the other two total only 260. It is evident, therefore, that the factor pair *I i* also belongs with the *C c Sh sh Wx wx* linkage group. The crossover percentage for *I i* and *Sh sh* in this case is 3.6. One of these backcrossed ears is shown on the right in Figure 22.

The very close approximation of the *Sh sh*—*C c* linkage relation by that of *Sh sh*—*I i* suggests three interesting possibilities. *C c* and *I i* are (1) very closely linked, (2) they are on opposite sides of *Sh sh* and approximately equally distant, or (3) they are allelomorphic. It is impossible at present to determine which of these possibilities is correct but investigations are now in progress which are expected to throw some light upon the problem.

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Fellowship in Crop Breeding

There will be a fellowship in the study of crop improvement at the Michigan Experiment Station, East Lansing, Michigan, to be filled on or before September 1st, 1921. It is a half-time fellowship, open to graduates of our Universities with farm experience or graduates of Agricultural Colleges, who have had a good course in genetics, the more genetics the better.

The holder of the fellowship is expected to complete a master's degree in two years, majoring in plant breeding and taking his minor in some other department. Half of his time will be devoted to actual crop improvement work, connected with the Department of Farm Crops.

The breeding work during the coming year will include work on corn, oats, rye, wheat, beans, alfalfa, clover, fiber, flax, hemp, potatoes, sugar beets, timothy, and winter vetch.

The candidate would need to furnish a copy of his grades from the Registrar's records, and give references to those who know of his abilities. The fellowship offers $800 for half time during each of two years. Interested persons should communicate with the Department of Farm Crops, Michigan Agricultural College, East Lansing, Michigan.

POLYDACTYLISM IN CATTLE[1]

ELMER ROBERTS
Agricultural Experiment Station, Urbana, Illinois

THE inheritance of extra digits or polydactylism has been studied in poultry, guinea-pigs and man. Its occurrence in cattle has been known for a long time and many cases have been recorded. Through the kindness of Dr. C. B. Olney who called my attention to its presence in a herd of dairy cattle owned by Mr. Paul Peglow, Prairie View, Illinois, an opportunity was afforded to note the inheritance of this character in cattle.

A normal bull mated to a polydactylous cow having three toes on each foot produced a female showing the same condition. Information concerning other offspring was not available. This latter female mated to a normal, unrelated bull has produced three male calves all of which were polydactylous. Two of these were like the mother having three toes on each foot, while the third had three toes on each front foot, four on one hind foot and five on the other. In the hind legs of this third calf there was said to be a duplication of the normal number of bones between the hock and the hoof, that is of the metatarsals.

Figure 28 illustrates graphically the inheritance of this character. Figures 26, 29 and 30 show the expression of the polydactylous condition in the dam of the three calves. Figure 25 is of the normal foot in cattle. It should be noted that the extra toes on front feet are much

COW'S NORMAL FOOT

POLYDACTYLOUS FOOT

Polydactylism is the possession, by man or animals, of more than the normal number of digits. The case described here is another proof of the inheritance of this abnormality. The polydactylous foot shown at the right above is a close view of the right hind foot of the cow pictured on the opposite page. (Figs. 25 and 26.)

[1] Paper No. 15 from the Laboratory of Genetics, Illinois Agricultural Experiment Station.

A GRADE HOLSTEIN COW WHICH HAS THREE TOES ON EACH FOOT

The mating of a normal bull to a polydactylous cow having three toes on each foot produced a female possessing the same condition. The latter female mated to a normal, unrelated bull has produced three male calves all of which were polydactylous. The inheritance of the abnormality in this case is outlined in the diagram below. (Fig. 27.)

smaller than those on the hind feet. In each case the third toe is on the inside. This would mean that the extra toe is probably a development of the I or II digit, and probably the II.

In poultry, guinea-pigs and man, the expression is variable. Sometimes it is dominant and at other times normal individuals produce polydactylous offspring. Also many other factors seem to influence its expression. In this case in cattle it is obviously dominant.

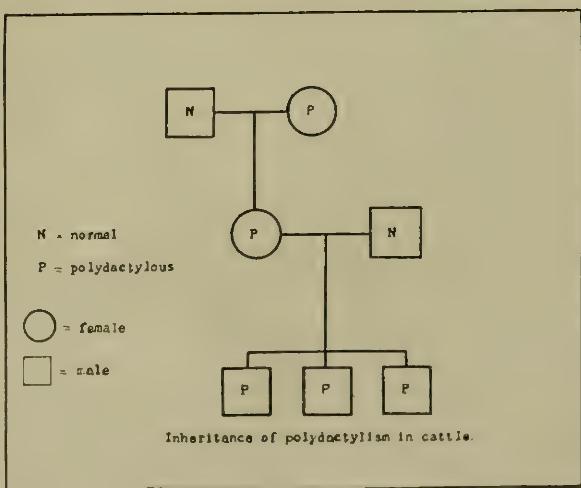

Fig. 28

HIND FEET OF THE POLYDACTYLOUS COW SHOWN IN FIG. 27 (FIG. 29)

FRONT FEET OF THE POLYDACTYLOUS COW SHOWN IN FIG. 27

Note the small size and asymmetrical position of the extra toes. In this case the polydactyly appears to be due to the recurrence of a latent ancestral digit and is thus comparable to polydactyly in guinea pigs. In human and feline polydactyly there is a symmetrical reduplication of one or more of the digits apparently due to an irregularity in development which is without atavistic significance. (Fig. 30.)

A TOOTHLESS TYPE OF MAN[1]

The "Bhudas" of India—A Case of Sex-linked Inheritance

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THERE occurs in the Hindu Amil community of Hyderabad Sind, a town in India, a type of men who have no teeth. These men are further characterized by a bald head and an extreme sensitiveness to heat. They are known as "Bhudas," which literally means "toothless." The following facts are known about them:

(1) When such a man (a Bhuda) marries a normal girl having both parents free from these defects, all the children, both males and females, are apparently normal—that is to say, apparently free from the defect.

(2) When the F_1 males marry normal females having both parents normal, their children, both males and females, are apparently normal.

(3) When the F_1 females marry normal males, their female children are apparently normal, while the male children are "Bhudas."

(4) No case is known in which a toothless man has married the daughter of a "Bhuda."

(5) No females have been found showing the anodont condition.

BIOLOGICAL EXPLANATION OF THE PHENOMENON

This is, apparently, a case of sex-linked inheritance in man. The inheritance of this toothless condition, as well as the associated defects of sensitivity and hairlessness, is a case in point, and the causative character seems to be carried by the sex chromosomes. The factors involved are: B for the normal condition, and its recessive allelomorph "b" for the toothless condition.

(a) When a female of the genetic constitution (BX) (BX) is mated to a male (bX) Y, we get:

	Genotypes	*Phenotypes*
F_1	(BX) (bX)	Normal females.
	(BX) Y	Normal males.

That is to say all the children are normal in appearance. This explains fact No. 1, stated above.

(b) Fact No. 2 is self-explanatory when we consider the genetic constitution of the F_1 male.

(c) Fact No. 3 carries us to the F_2 generation. When an F_1 female (BX) (bX) marries a normal male (BX) Y, who has the same genetic constitution as her F_1 brother, then we shall get:

	Genotypes	*Phenotypes*
F_2	(BX) (BX)	Normal female.
	(BX) (bX)	Normal female.
	(BX) Y	Normal male.
	(bX) Y	Toothless male.

The following points are worth noting:

(1) We expect all females to appear normal; this is what acutally happens in practice. So the theoretical expectations coincide with the practical results.

(2) Of the males we expect some toothless, some normal, strictly speaking one to one. Now let us see what actually occurs in practice. The general belief is that all males are toothless, but this is a matter for further investigation. At the same time, the absence of normal males in the F_2 generation in actual practice can be explained by taking into consideration the fact that only one individual is produced at a time, therefore the chances of one of the phenotypes not appearing at all, or another appearing repeatedly, are as great as the chances of all the phenotypes (comprising 4 genotypes in the present case) being represented in a single generation. In order that all of the phenotypes may appear, we must have a sufficient number of individuals under observa-

[1] A preliminary report.

tion, a condition not under control. But the fact remains that there is a possibility of any of the phenotypes not already observed appearing sooner or later. So that whenever such appear, they are easily accounted for. Further, we must note that in the practical observations that are known to us, there is nothing that can not be accounted for; there is nothing that conflicts with our theoretical expectations.

(3) The Mendelian ratio of 3 : 1 in the F_2 generation is apparent, but we have no data as to how far it is attained in actual practice. However, we must remember that this ratio should be looked for only in those organisms in which a reasonably large number of individuals are born in a generation.

(d) Facts Nos. 4 and 5 are interrelated, one being the cause, and the other its effect. A toothless female (bX) (bX) can only result when a heterozygous female (BX) (bX) is mated to a toothless male (bX) Y, a condition not yet attained in practice.

CONCLUSION

(1) The toothless man seems to be an example of regressive mutation.

(2) The phenomenon of heredity in the toothless man is strictly a case of sex-linked inheritance, as all the existing facts are in conformity with our theoretical expectations based on Mendelian laws of Segregation and Dominance.

PRACTICAL SIGNIFICANCE

Since heredity in the toothless man obeys the laws of Segregation and Dominance, we can predict some of the important facts summarized below.

(1) A normal male, even if he is a son of a toothless man, has no contamination of this defect in his germplasm; no fear need be entertained about his carrying the defect in his germ without he himself showing it.

(2) The daughter of a toothless man, altho she does not show the defect in her body, carries the contamination hidden in her germplasm and will produce, on union with a normal male, some toothless children, and these will be males, with the complete exclusion of the toothless female children. But if she marries a toothless male there is a possibility of her producing both toothless and normal females, and also both toothless and normal males.

(3) Should, at any time, a toothless female appear, and should she marry a toothless man, then all their children, whether males or females, will be toothless without exception.

INFORMATION WANTED

The writer of this article would be glad to hear from anyone who can report if, at any time, any of the toothless men ever had (or has) a brother (from the same mother) who was normal, that is to say, was *not* a "Bhuda"; if any of his sisters (from the same mother) had all toothless sons while another had some normal sons.

The Diseases of Infancy

LEITFADEN DER KINDERHEILKUNDE für Studierende und Aertze; erster Teil, SÄUGLINGSKRANKHEITEN; 4te, verbesserte Auflage. Von Dr. Walter Birk, professor d. Kinderheilkunde a.d. Universität Tübingen. Pp. 269, broschiert M. 12.50, gebunden M.15.50. A. Marcus and E. Webers' Verlag, Bonn, 1920.

Dr. Birk lays out his subject methodically and sticks to it in a practical way that gives little opportunity for excursions into the field of genetics; although much might be written on the part that heredity plays in the diseases of the first year of life. His brief remarks on the frequency with which twins show marked difference as regards constitutional disease, make one desire further elaboration on this point.—P. P.

INBREEDING AND CROSSBREEDING

The Effect of Inbreeding and Crossbreeding in a Wild Plant of the Sunflower Family[1]

J. L. Collins
University of California

EVEN in very remote times the mating of closely related individuals in both the human race and in animals was considered to give rise either sooner or later to harmful or even disastrous results. Although such ideas contained much that was myth and superstition they were certainly founded on facts of such a nature that they could not be overlooked. Without this nucleus of fact the idea of evil resulting from inbreeding could not have persisted as it has through centuries.

It is only in the more recent of modern times that a logical explanation of the causes of such results has been made. A consistent explanation was possible only after a more thorough understanding of some hereditary phenomena in general had been worked out.

INBREEDING AND HEREDITY

In the cells of which a plant or an animal is composed there are a definite number of small particles of protoplasm called chromosomes. These chromosomes are supposed to carry the determiners called genes of factors for the characters which are hereditary. If the gene for a particular character is not present in the chromosome, that character will not be produced in the mature individual. Much of our knowledge relating to the causes of inbreeding and crossbreeding effects have come from experiments on inheritance in maize.

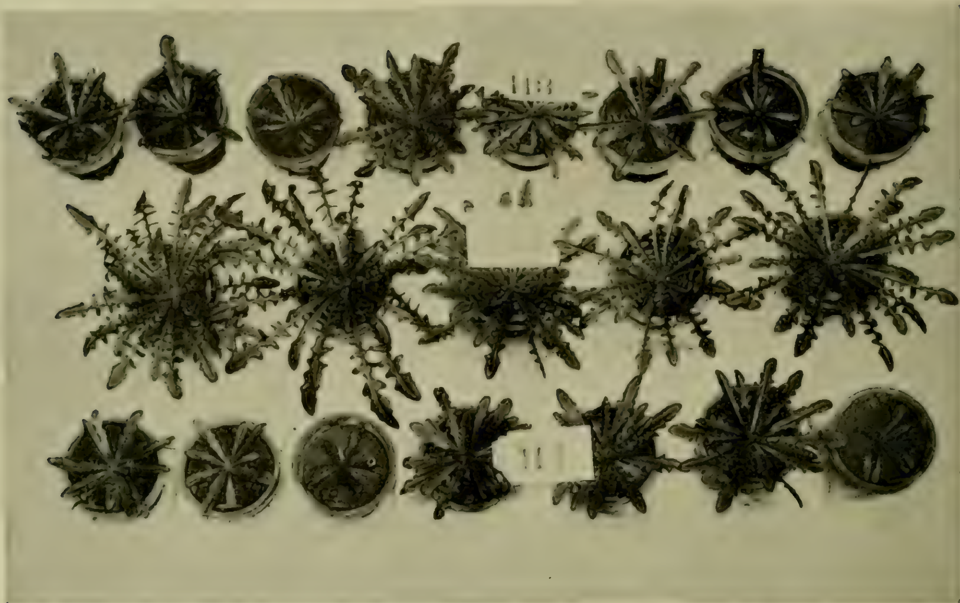
It has been shown that inbreeding itself produces no evil results, but that the characters which appear do produce an evil result because the hereditary gene or factor by which the character is conditioned is already present in the germplasm. If no such genes are present in the germinal material then no amount of inbreeding can produce them. In fact, inbreeding is now considered as a method of testing the hereditary material to determine if it carries the genes for any hidden or recessive characters. The fact then that inbreeding produces abnormal forms and a reduction of vigor in some species and not in others is due to the presence or absence of the genes in the germplasm. For example, no such results attend inbreeding in such self-fertilized crops as barley or beans because in them self-fertilization is the normal method of reproduction and these plants are homozygous for all their genes, all the abnormal and weak plants having long ago segregated out of the race and perished in the struggle against their more hardy sister plants, without leaving any progeny to perpetuate their kind.

CROSSED AND SELF-FERTILIZED PLANTS

Maize, on the other hand is a naturally cross-fertilized plant and heterozygosity is the general condition of the germinal material instead of homozygosity as in the case of the self-fertilized species. In this heterozygous condition the genes for these recessive harmful or abnormal characters may be carried along in the chromosome under the protection of the hardy, useful, dominant characters and manifest their presence only in the absence of the latter. Inbreeding in a naturally cross-fertilized species furnishes conditions favorable for the meeting of these recessive genes in the zygotes and hence their appearance in some of the individuals.

The increase in size and vigor observed in the progeny when two inbred strains or an inbred and unrelated non-inbred strains are crossed is due to the establishment of a heterozygous germplasm containing more dominant genes influencing size and vigor than

[1] By invitation.



MORE VIGOROUS HYBRIDS WITH LESS VIGOROUS INBRED WILD PLANTS

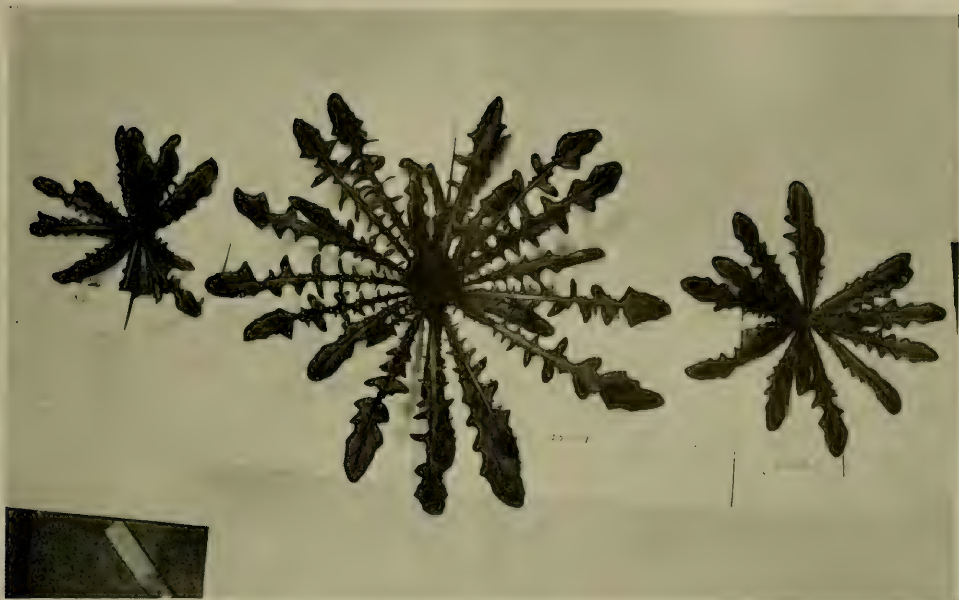
Crepis capillaris is a wild plant of the sunflower family. It is a native of the Mediterranean countries, and is growing wild in North and South America. Plants grown from seeds which were collected in two widely separated parts of California have shown interesting effects of cross-breeding and inbreeding. The hybrid plants (in the centre row) between inbred plants of the same age show pronounced hybrid vigor and development. (Fig. 31.)

were present in either of the parents. The linkage of such dominant genes to recessive genes or to dominant genes that influence size or vigor adversely reduces the possibility of securing such dominant races in a homozygous condition. For this reason the vigor noticed in the F_1 generation is less marked in the F_2 and subsequent generations where segregation and recombination of the genes of the F_1 are made evident. Most of our knowledge regarding inbreeding and crossing of inbred strains has been derived from experiments on maize, a plant which has been subject to artificial selection for centuries since its domestication. The question has arisen whether a cross-fertilized species which had never been domesticated and thus subjected only to natural selection would exhibit inbreeding and cross-breeding results similar to that described above. The answer to such a question will require controlled experimentation upon a number of species, but a beginning has been made with *Crepis capillaris*, a wild cross-fertilized plant belonging to the sunflower family.

INBREEDING REDUCES VIGOR AND SIZE IN CREPIS

Crepis capillaris is a native of the old world, found particularly in the countries about the Mediterranean and spreading out over Europe, Asia, Africa and adjacent islands. It has been introduced and is growing wild in both North and South America. The flowers are perfect, and both cross and self-fertilization takes place. No records have been found where this plant has been subjected to extensive selection or domestication inasmuch as it has no properties of economic value.

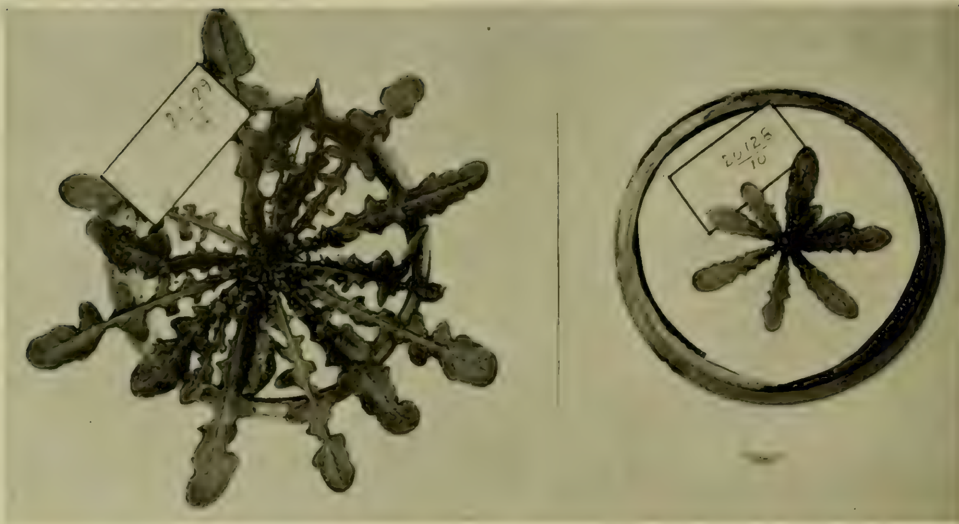
Seed collected from wild plants growing in two locations about 300 miles apart in California were used in the experiments of inbreeding. At the beginning of the experiment the plants were very similar in most characters and in size. The practice of inbreeding was started to purify the material which obviously was heterozygous. In the second generation of inbreeding there was some evidence of reduction in vigor and size, but the results of the 3rd and 4th generations left no question as to what was taking



ONE HYBRID PLANT (IN THE CENTRE) AND TWO INBRED PLANTS FROM THE GROUP SHOWN ON THE OPPOSITE PAGE (FIG. 32)

SAME PLANTS AS THOSE ABOVE PHOTOGRAPHED SIX WEEKS LATER

This shows the rapid development of the hybrid (at the left) which has produced a flower while the inbred plants have not started to produce a flowering stalk. (Fig. 33.)



A FIRST GENERATION HYBRID COMPARED TO AN INBRED PLANT

The greater vigor of the hybrid at the left is evident in this comparison with the inbred plant which shows slower development and total size. Both hybrid and inbred plants were grown in both four and six inch pots but the increased root space and quantity of soil did not alter the relation of vigor in the plants. (Fig. 34.)

place. These plants were smaller and much slower in growth than non-inbred plants. Inbreeding in this wild plant which is in nature largely cross fertilized does cause marked reduction of vigor and rate of development. Thus both they and maize behave in a similar way when subjected to inbreeding.

When inbred non-related strains of corn are crossed the progeny show a return to the size and vigor of the parents before inbreeding was practiced. In order to compare the wild plant Crepis with the domesticated plant maize in this respect, the inbred strains of Crepis were crossed together and to non-inbred strains. The results (Figs. 31 to 34) of these crosses again confirmed the similarity of the behavior of inbred maize and inbred Crepis.

The plants under domestication are not subjected to the same severe natural selection agencies common to wild plants. It is therefore possible for characters to exist in cultivated plants which would not be able to persist in a wild state. One would expect that the germplasm of wild species would be to a considerable extent purified of the genes which cause the production of harmful and abnormal characters by the elimination of most of the weak forms through natural selection. These experiments with Crepis however show that the germinal material is far from being in a state of purity or a state of homozygosity. If it had been nearly homozygous little reduction would have resulted when continued inbreeding was practiced and we would have had a condition similar to that in barley, wheat and peas where inbreeding (the normal method of reproduction) does not cause a reduction in general vigor or in rate of growth.

FOUR GENERATIONS

In Figure 31, cultures 113 and 114 are plants that have been subjected to inbreeding for four generations. The plants marked 115 are F_1 hybrids produced by crossing the inbred strain to a non-inbred and non-related strain. All plants were grown in four inch clay pots and were arranged, during their growth period, with hybrid plants between inbred plants as in Figure 31.

Inbred and hybrid plants were also grown in six inch pots but as shown in Figure 34, the increased root space

and quantity of soil did not alter the relation of vigor between inbred and hybrid plants. The marked increased rate of growth and development of the hybrid plants is shown in Figures 32 and 33 which represent the same plants, a time interval of six weeks between photographs. In Figure 34 the hybrid plant is in flower and has been bagged in order to secure the hybrid seed. The inbred plants are so much slower that they have not started to produce a flowering stalk. The similarity of behavior of maize and Crepis regarding inbreeding and crossing of inbred strains indicate a certain similarity of germinal conditions between a species long domesticated and thus subject to artificial selection and a wild species which has never been subjected to such selection.

This brings up a question whether domestication of a cross-pollinated species accompanied as it is with artificial selection changes in any appreciable extent the relations of the factors conditioning vigor, rate of growth and development from the relations they had in the wild species from which the domesticated species originated.

INHERITANCE OF MENTAL TRAITS

Evidence that Heredity Determines the Make-up of the Mind as Well as the Body Is Reviewed by Starch

Paul Popenoe

SO LONG as psychologists depended on introspection for their science, it was possible for some of them to believe that mental traits are not inherited. The doctrine of the child's mind as a blank sheet of paper, on which the environment and the teacher wrote their autographs, had followers.

But with the development of precise and objective methods in psychology, students were rapidly forced to realize that the mind was not in a realm by itself; for they came up against facts that could be satisfactorily interpreted only by the supposition that differences in mental ability are inherited in the same manner as, more obviously, are differences in physical ability.

Thus it is, according to Daniel Starch, that among psychologists "the view held by most scientific students of the problem today gives weight to both elements, with perhaps the major emphasis on heredity."

Dr. Starch's recent and well-documented book[1] on educational psychology discusses three of the numerous lines of evidence that have caused this recognition of the importance of heredity. These lines are: (1) The similarity of abilities among related persons; (2) the influence of uniform environment on different original abilities; and (3) the influence of different environments upon similar original abilities.

THE HISTORICAL APPROACH

1. Correlation of abilities may be studied most conveniently either at one extreme of the population or the other; either among those who are talented or among the feeble-minded and other defectives. The problem was first attacked, historically speaking, among the eminent, by Francis Galton, and was followed up much later by Frederick Adams Woods.

Galton made a study [published in 1869] of 977 eminent men, each of whom was the most eminent among 4,000 persons. He proceeded to determine how many relatives of equal eminence and of varying degrees of relationship each person possessed. In this manner he found that these 977 men had the following relatives of a like degree of eminence: Fathers 89, Brothers 114, Sons 129, Grandfathers 52, Grandsons 53, Uncles 53, Nephews 61; Total 535.

[1] Educational Psychology, by Daniel Starch, Ph.D., University of Wisconsin. New York: The Macmillan Co., 1920. Pp. 473, with 96 text figures.

"Galton further pointed out that 977 ordinary men, selected by chance from the population at large, would have only four such eminent relatives. He concluded as follows:

"(*a*) That men who are gifted with high abilities easily rise through all the obstacles caused by inferiority of social rank.

"(*b*) Countries where there are fewer hindrances than in England, to a poor man rising in life, produce a much larger proportion of persons of culture, but not of what I call eminent men. [England and America are taken as illustrations.]

"(*c*) Men who are largely aided by social advantages are unable to achieve eminence, unless they are endowed with high natural gifts."

In 1906 F. A. Woods published his study of "Heredity in Royalty," in which he analysed the principal reigning houses of Europe, showing that the really great persons in them were closely interrelated and that the right of succession to the throne, which gave great opportunity to a man to achieve distinction, did not suffice to produce real greatness where it did not germinally exist as the result of inheritance. Dr. Woods concluded that heredity "explains at least 90% of the intellectual side of character in every case," an induction that Dr. Starch thinks is too high.

At the other end of the scale, among the defectives, delinquents, and degenerates, there is no lack of studies, largely American, to show how feeblemindedness, for example, runs in families. The Jukes, the Zeros, the Kallikaks, and others are cited by Dr. Starch, somewhat uncritically.

BAD ENVIRONMENTS

"To one who wishes to argue in favor of environment as the chief determining element in ability and character," he goes on, "such data as have been presented from family histories and relationships are not entirely convincing. It might be argued that a given family has so many individuals of high or low intelligence and achievement because its members were born in circumstances which did or did not afford opportunities for development and training and for achieving higher success. It might be said that the descendants of the [Jonathan] Edwards family were born and reared among favorable circumstances of educational and financial advantages and consequently were fitted for greater tasks and lived in an environment in which larger opportunities offered themselves, whereas the members of such a lineage as the Jukes family would have just the opposite environment of birth, education, and opportunity in life.

"In answer to all this, we must remember, however, that ability very largely determines the sort of environment in which a person is satisfied to live, that a really capable person is quite likely to push forward and to find a way out of the environment in which he may happen to have been born, or to improve it if he cannot leave it, and, finally, we must remember that the persons of low ability were born in circumstances of a correspondingly low nature because of the hereditary stock of the families from which they came. Their parents were content to live under the circumstances under which they did live, because their abilities and desires sought for nothing better."

BROTHERS AND SISTERS

Dr. Starch then proceeds to the correlations of measurements between brothers and sisters in mental traits which, just as for physical, average around +0.50. He describes a study of his own on students of the University of Wisconsin in which it appeared that "the resemblance of siblings is apparently no greater in those mental traits which are directly affected by school work than in those which are not so affected. The average correlation in the former group of tests is 0.42 and in the latter 0.38. This seems to indicate that the mental similarities of children of the same parents are due primarily to heredity rather than to similarity of environment, since the resemblance is no greater in those traits, which are more directly affected by environment."

Similar work by E. L. Earle is explained. The conclusion of this investigator was that "abilities in special subjects are inherited, apparently to no greater extent in one subject than in another. What is probably inherited is either general scholarship or else more specialized traits than ability in arithmetic, or ability in language. Each study involves many mental faculties and nearly all studies involve the same faculties with varying emphasis.

"There is no evidence, at least from these figures, for the notion that special abilities in certain studies run in families. Mental traits running in families are very likely more specialized than abilities in school studies which involve large groups of mental functions. The children of any given family are on the average equally good or equally poor in all studies. Ability in school work is apparently inherited to the same extent as physical features, since the coefficients of correlation for children of the same parents are approximately the same for both physical and mental traits."

The study of 185 pairs of sibs in the University of Wisconsin, made by Miss Emily S. Dexter, showed a resemblance of about 0.60 in scholarship records in various subjects. Her judgment is "that inheritance, to a much greater extent than training, is responsible for the degree of resemblance found." One of the bases of this judgment is that sibs of opposite sex were found to be more closely correlated than those of the same sex.

Several other studies of this sort, and the *familiar* studies of twins by Francis Galton and by E. L. Thorndike are also cited.

EFFECTS OF PRACTICE

2. The influence of uniform environment upon different original abilities has been measured by various psychologists. "All experimental results point in the direction that practice does not equalize abilities," Dr. Starch declares. "In fact, equal practice tends to increase differences in achievement and skill rather than to decrease them. The more gifted individuals profit more, both relatively and absolutely, than the less gifted. This experimental fact is one of the most profound bits of evidence regarding the whole problem of heredity and environment. The talented men not only start with greater initial capacities but seem also to be capable of more intense application and more zealous desire to improve. 'To him that hath shall be given' is psychologically true in the sphere of intellectual training as well as in the sphere of morality and religion."

"If we may generalize for life as a whole, equal opportunities for all do not produce equal abilities in all. Men may be born free politically; but they are not born equal mentally; they may be born equal in opportunities in a democratic society, but they certainly are not equal in their ultimate achievements in life."

3. Influence of different environments upon various original abilities has likewise been tested by more or less exact methods on many different occasions. Dr. Starch considers these studies somewhat uncertain in interpretation; they can be made to prove anything. He has, however, ignored one of the strongest pieces of evidence under this head, which is a matter of every-day observation—namely, the persistence of inherited qualities in brothers and sisters who are brought up in widely separated surroundings. The case is the more striking if twins are studied.

Indeed, it is easily possible by more methodical classification of the data available to make out a much stronger case for heredity than Dr. Starch has done. His case, however, is strong enough to make him say:

THE CONCLUSION

"The general impression from all experimental, statistical, and historical material thus far accumulated on the problems of mental heredity would seem to be somewhat as follows: Barring paupers, invalids, and those suffering from want of food and shelter due to conditions beyond their personal control, and referring to all others liv-

ing in the same community at the same time, the ultimate achievement of any given individual is due to his original ability, probably to the extent of 60% to 90%, and to actual difference in opportunity or external circumstances only to the extent of 10% to 40%."

"The facts of heredity bear down so heavily," he continues, "that the impression gained of the large part played by it leads one almost to a fatalistic philosophy. One is almost inclined to believe that persons become what they do largely on account of their hereditary capacities, and that they are not in the least responsible for their own outcome; that if a person is born with great capacities he will achieve high distinction, and if he is born with mediocre or slender capacities he will not achieve anything beyond his limits, no matter what he may do.

"While it is certainly true that no one may achieve a position higher than his original capacities will permit, it does not follow that a mechanical, fatalistic view needs to be taken. Nature predominates enormously over nurture only in the relative and not in the absolute sense.

THE POSSIBILITIES OF NEWTON

"This distinction must always be borne in mind in studies of heredity. In fact, in the absolute sense, nurture predominates enormously over nature. A Newton born among Australian bushmen would no doubt have become a remarkable bushman, but never a world-renowned scientist. The necessary stimuli of environment must be at hand to train and develop original capacities.

"The difference between relative and absolute achievement may be illustrated in any of the experimental results concerning the effects of equal practice, cited in a preceding section. The fact that all individuals improve by practice shows absolute gain in performance or skill. The fact that the gifted ones maintain their lead, or even gain in their lead, is relative achievement. Before practice, no child can write; after practice, all normal children can write with more or less excellence. This is absolute gain. Before practice, some children have greater original capacities for learning to write; after practice, these same children maintain the same superiority. This is relative gain.

"A Newton and an ordinary bushman born and reared among bushmen would probably be superior and ordinary bushman respectively. A Newton and an ordinary bushman born and reared in New York City at the beginning of the twentieth century would probably become, respectively, the one a great scientific, professional, or business man, and the other an ordinary person, able to get on, earn a living, and enjoy life within the ordinary limits.

THE PRESSURE OF CIVILIZATION

"The original abilities of ancient civilized peoples were probably very little different from the original abilities of modern civilized peoples. The differences are probably due to the transformation of the environment, which is constantly being brought about through the efforts of man. A Newton born in a modern civilized community would have greater and different stimuli than one born in an ancient or uncivilized community. His ultimate eminence would be determined by his environment.

"The pessimistic air may be further dispelled by noting the fact that hardly one person in a thousand makes all the absolute gain possible for him even in a single capacity. It has been proven over and over again in numerous abilities which have been used daily in one's occupation that by a little special practice each day their efficiency can be enormously improved. Consequently, while the possibilities of each individual are limited by his original inherited equipment, each one may develop his capacities far beyond the normal degree of attainment.

"While experimental evidence indicates emphatically that under equal opportunities the more gifted surpass the less gifted, yet rarely does anyone do his best or attain his limit even in a single capacity. Life is a matter of competition: let everyone compete to the fullest extent of his inherited ability."

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A FLOWER OF THE PIMA VARIETY OF AMERICAN EGYPTIAN COTTON

Showing the organs of reproduction. As in most members of the Mallow Family, to which the cotton plant belongs, the pistil is partly enclosed in a sheath on which are borne the numerous stamens or pollen containers. Pollination takes place on the portion of the pistil which extends above the sheath. The illustration shows a section through the ovary, the enlarged basal part of the pistil, exposing the ovules. The grains of pollen germinate and send long tubes down through the pistil into the ovary. When a pollen tube comes into contact with an ovule the process known as fertilization is effected. The fertilized ovule then develops into a seed. (Frontispiece.)

POLLINATION OF PIMA COTTON IN RELATION TO THE YIELD OF SEED AND FIBER

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A PAPER in the Journal of Heredity for October, 1918, by Rowland M. Meade, entitled "Beekeeping may increase the cotton crop," published after his untimely death, described experiments with the Durango and Acala Upland varieties of cotton at San Antonio, Texas. The results indicated that when the flowers were pollinated more thoroughly than is ordinarily the case under natural conditions at that locality, the bolls contained a greater number of seeds. Meade concluded that "growers of long-stapled varieties might find beekeeping a distinct advantage to the cotton crop." It is important to know whether the same conclusion holds good with the Egyptian type of cotton, as grown in Arizona.

DESCRIPTION OF THE COTTON FLOWER

A few words in regard to the structure of the cotton flower are necessary to make clear what follows. The center of the flower is occupied by a long slender organ, the pistil, which ends at the base in a cone-shaped structure called the ovary. If the ovary is cut open it is found to contain numerous small white bodies, the ovules. The greater part of the length of the pistil is enclosed by a thin sheath which bears numerous stamens, the organs which contain the pollen. The grains of pollen, falling upon the portion of the pistil which projects above the top of the sheath, germinate and send out slender tubes which grow down through the pistil until they reach the ovules. When a pollen tube comes into contact with an ovule, fertilization takes place and the fertilized ovule develops into a seed while the container, the ovary, increases in size and becomes the boll.

Examination of the Egyptian cotton flower shows that the white pistil extends far above the column of bright yellow stamens (see Frontispiece). If a flower is enclosed in a paper bag, so that insects are kept out, it will be found that the pollen, which looks to the naked eye like golden dust, is deposited only upon the part of the pistil which is just outside the sheath and is surrounded by the upper stamens. The club-shaped summit of the pistil receives pollen only when it is carried there by insects. Observation has shown that the cross pollination of cotton flowers is accomplished chiefly by bees and wasps. The honey bee is often very efficient as a pollinator but sometimes prefers to work on the nectaries outside the flower rather than within the blossom.

INSECTS ABUNDANT ONLY IN SOME LOCALITIES

At Sacaton, on the Pima Indian reservation in southern Arizona, where such insects are abundant, the entire free surface of the pistil is usually found to be thickly coated with pollen soon after the flower opens in the morning. But in the heart of the cotton growing district of the Salt River Valley, at distances of 25 to 40 miles from Sacaton, numerous observations in 1919 and 1920 showed that pollination is much less complete. Even late in the afternoon the tops of the pistils are often as white and as free from pollen as when the flowers are bagged to insure self-fertilization. Visits to fields on the outskirts of the Valley, at Litchfield and at Goodyear, on the contrary, showed the flowers to be as well pollinated as at Sacaton. The difference in these several localities is doubtless due

to difference in the number of insects. The acreage has been so large during the last two years that near the center of the cotton growing district there have not been enough insects to "go around," whereas farther out towards the desert there are more bees and wasps in proportion to the number of cotton flowers.

GREATER NUMBER OF SEEDS FROM INSECT POLLINATED FLOWERS

In order to determ ne whether the less thoroughly pollinated flowers produce fewer seeds than flowers which are completely pollinated a simple experiment was planned by the writer and was carried out last summer under the immediate supervision of Mr. W. F. Gilpin, ass sted by Messrs. R. D. Martin, C. J. K ng and G. J Harrison. Several hundred flowers were marked by tags and left to natural pol ination. In an equal number of flowers the upper part of the pistil received a thorough applicat on of pollen from other Pima flowers. The experiment was performed both at Sacaton and in a field near Phoen x in the Salt River Valley where it had been observed that the flowers were not being thoroughly pollinated by natural means. All bolls which developed from both lots of flowers were harvested in the fall and the number of seeds in each boll was counted. From these data it was easy to compute how many seeds were obtained from each lot of flowers. The average numbers of seeds per 100 flowers were as follows:

	Phoenix	*Sacaton*
Naturally pollinated flowers	1157±26	1520±15
Hand-pollinated flowers	1526±19	1496±16

It is evident that the naturally pollinated flowers yielded a much larger number of seeds at Sacaton, where bees and wasps were abundant in the cotton fields, than in the field at Phoenix where such insects were much less numerous. The better pollination under natural conditions at Sacaton not only resulted in a higher average number of seeds per boll but allowed a higher percentage of bolls to set than was the case at Phoenix. It is therefore not surprising that hand pollinating the flowers greatly increased the seed production at Phoenix, but had practically no effect at Sacaton, where hand pollination was a mere formality, the pistils having been already well covered with pollen by their insect visitors. The hand-pollinated flowers at Phoenix yielded practically the same number of seeds as did the naturally pollinated flowers at Sacaton.

THOROUGH POLLINATION ALSO INCREASES YIELD OF FIBER

These results leave little room for doubt that more thorough pollination results in a larger yield of seed. But, the reader will ask, is the yield of fiber likewise greater when more pollen reaches the pistils? A record was not kept of the quantity of fiber produced in the experiment just described but evidence from another source is at hand.

Twelve samples of seed cotton, each consisting of 100 bolls from as many plants and each obtained in a different field, were collected in the Salt River Valley in 1920. All the samples were kept for several weeks under uniform conditions and were then carefully weighed and ginned. The number of seeds in each sample was determined and the total weight of fiber was calculated by subtracting the weight of the seeds from the weight of the seed cotton. It was then a simple matter to compute for each sample the lint index or average weight of fiber per 100 seeds, which expresses the relative abundance of the fiber on the individual seeds.

A study of the data thus obtained showed that there was no correlation between the average weight of fiber per seed and the average number of seeds per boll. In other words, there was no evidence of a tendency for the fiber to be more abundant on the seeds in bolls containing few seeds than in bolls containing many seeds. On the other hand, the weight of fiber per boll was found to be very closely correlated with the abundance of the fiber on the

individual seeds (lint index) and also to be correlated, although less closely, with the number of seeds in the boll. It follows that if there were no variation in the abundance of fiber per seed in different bolls, the quantity of fiber yielded by each boll would be directly proportional to the number of seeds it contains.[1]

There can be no doubt, in the light of these facts, that thorough pollination, which results in an increased number of seeds per boll, also increases the yield of fiber. What, then, can the cotton grower do to insure effective pollination? It is, of course, not in his power to increase the number of wild bees and wasps which visit his cotton flowers but often honey bees also are effective pollinators. It would therefore seem desirable to encourage the keeping of bees in the vicinity of the cotton fields and to watch their behavior in relation to the crop.

[1] The coefficients of correlation for these twelve samples, a perfect correlation being indicated by the value 1.00, were as follows:

Weight of fiber per boll with number of seeds per boll, ...r .48 ± .11
Weight of fiber per boll with lint index...r= .90 ± .03
The partial correlation weight of fiber with number of seeds for constant lint index, gave a value for r of .98 ± .006.

FOREIGN-BORN WHITE FARMERS IN UNITED STATES

There were 581,054 foreign-born white farmers in the United States in 1920, according to the Fourteenth Census, as compared with 669,556 in 1910. This represents a decrease of 88,502, or 13.2 per cent, for the decade. The decrease in foreign-born farmers was largely the result of the war, on account of which large numbers returned to their native countries. The decrease in the number of German-born farmers alone was 81,148. White farmers born outside the United States constituted nine per cent of the total number of farmers in the country in 1920, as against 10.5 per cent in 1910.

There are very few foreign-born farmers in the South, except in Texas. They are most numerous in the North Central states, although there are considerable numbers in the Pacific states; and a relatively high proportion of the total number of farmers in some of the Eastern states is foreign-born.

The states reporting the largest numbers of foreign-born white farmers in 1920 were as follows: Minnesota, 67,305; Wisconsin, 53,998; Michigan, 48,264; North Dakota, 36,248; and Iowa, 32,221. In Minnesota the foreign-born white farmers formed 37.7 per cent of all farmers in 1920; in Wisconsin, 28.5 per cent; in Michigan, 24.6 per cent; in North Dakota, 46.7 per cent; and in Iowa, 15.1 per cent.

COUNTRIES FROM WHICH FARMERS COME

The foreign countries which contributed the largest numbers to the ranks of the foreign-born white farmers in the United States, as reported for 1920, were Germany, with 140,652; Sweden, with 60,442; Norway with 51,596; and Canada, with 48,692. It should be noted that this order by no means corresponds to the order in which the various foreign countries have contributed to the total population of the United States. The immigrants from certain countries, notably Italy, Poland, and Ireland, have gone chiefly into pursuits other than agricultural.

Of all the foreign-born white farmers in the United States in 1920, 24.2 per cent were born in Germany, 10.4 per cent in Sweden, 8.9 per cent in Norway, and 8.4 per cent in Canada.

The states showing the largest numbers of German-born farmers in 1920 were Wisconsin, with 18,032; Minnesota, with 14,731; and Iowa, with 12,730. Of the farmers born in Sweden, 16,934, or more than one-fourth, were in Minnesota. Of those born in Norway 14,925 were in Minnesota, and 10,900 in North Dakota.

COLOR INHERITANCE IN CATTLE

Experiments with Dutch Belted Cattle When Purebred and Crossed with Dutch Pied Cattle—Peculiar Numerical Relation Between Belted, Self-Colored and Pied Calves Produced

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Havelte, Holland

SINCE Dr. Sewall Wright included in his series of excellent papers on "Color Inheritance in Mammals" (Journal of Heredity, 1917-18) an exposition of his views relative to cattle, Mr. R. Houwink, of Meppel, and some other breeders of Belted Cattle in Holland have proceeded to make some experiments, the results of which cannot fail to interest the American reader. I will, therefore, set forth the essential features of these experiments, a more detailed description and analysis having been published in the Dutch periodical *Genetica*, 1920. II.

As the reader will remember, the explanation of the phenomena of heredity in cattle is made somewhat difficult by the fact that the genetic behavior of apparently similar characteristics is often different in different breeds. Characters which are dominant in one breed appear to be recessive in another. White may be dominant in Chillingham Cattle and recessive in Pembroke and Highland Cattle, but the heterozygous state may also be distinctly intermediate, e.g., in the roans of the Shorthorns. Again, the factors producing the piebald pattern have not the same effect. The white face seems to dominate always over the black. Piebald cows when crossed with self-colored ones mostly produce intermediate piebald calves. (Mr. Kiesel's experiments with Limburger Fleckvieh.) At the same time the question is still being discussed whether the determining factors are independent or "polygamic" (Wilson). The former view appears to be the most plausible.

EXPERIMENTS WITH BELTED CATTLE (FIG. 1)

The experiments may be divided into two groups: (a). Pure breeding (b). Crossing with other Dutch Breeds.

(a). Experience in breeding Dutch Belted Cattle shows that the calves born are not always belted but sometimes self-colored. In this case they are mostly coal-black, but occasionally when both parents are heterozygotes as regards black hair, plain red calves were produced. In the pure breeding of red belted cattle, too, some cases are positively known in which self-colored calves, in the present instance naturally red, were produced. The phenomenon seems to decrease as belted cattle are bred true for a greater length of time. It is only after the infusion of fresh blood that self-colored calves occasionally make their appearance again.

In 1918 Mr. Houwink at Meppel obtained one black calf and four belted ones from five belted cows, bred to the same belted bull (See Fig. 4). Mr. Jochems at Wassenaar (near The Hague), obtained 45 calves from such matings (between 1912 and 1918) of which six were self-colored, one of these being red.

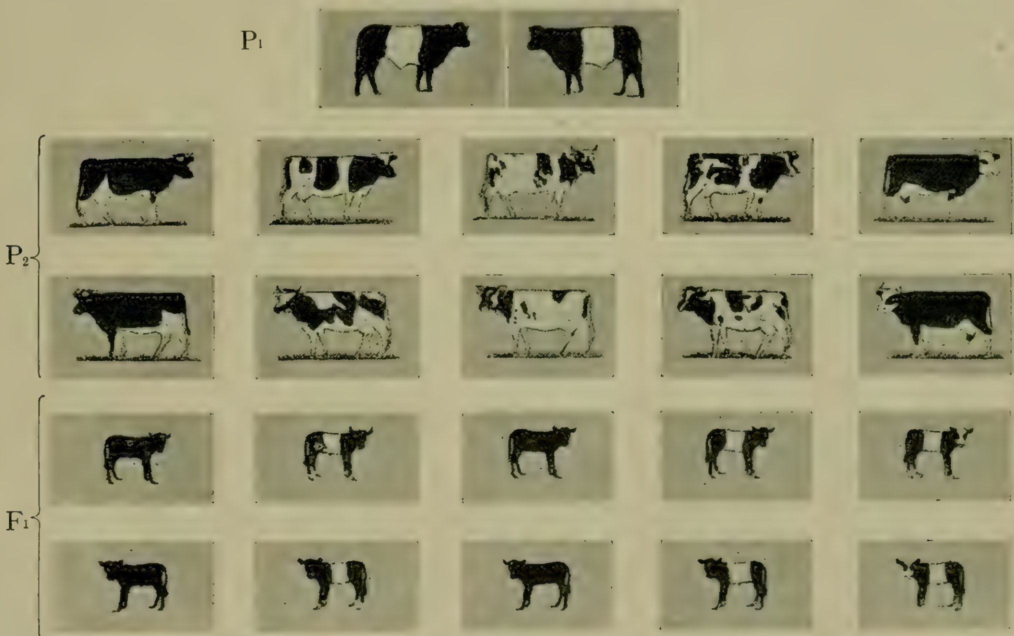
Another phenomenon in pure breeding that requires our attention is the frequent production of poorly marked calves. I shall refer to this presently in analyzing the facts.

EXPERIMENTS IN CROSSBREEDING

(b). The most important results as regards the crossing of Belted and Pied Cattle was obtained in 1918-1919 when rather more than 60 heifers were bred to a belted bull belonging to Mr. Houwink. (Figs. 3 and 5.) All of these heifers were piebald. Most of them were black with more or less white; but there were six red and white and one white-faced cow with

A DUTCH HERD OF BELTED CATTLE

The remarkable uniformity of the white pattern in this breed of cattle is a striking illustration of the laws of heredity. To retain perfection in the pattern it is necessary to keep the cattle purebred, as the introduction of new blood, even from a pure strain of the same variety, may upset the coat color. The breeding of these cattle in Holland has been declining except for ornamental purposes, as it is found that in breeding solely to obtain the pattern, the other desired qualities of the animals were impaired. (Fig. 1.)



RESULTS OF CROSSING BELTED AND PIED CATTLE

This diagram illustrates the matings of the Lakenvelder (Dutch Belted) bull, Albert Wassenaar, with five piebald cows of the breed called Holstein-Friesian in America. P_1 illustrates both sides of the bull, P_2 both sides of each of the five cows, and F_1 the five calves. The fourth cow was red, the others black. Note the production of solid black calves by two of the cows. The sire was shown to transmit self color in matings with cows of his own breed (See Fig. 4). Note the transmission, by the fifth cow, of the white face similar to that of a Hereford. (Fig. 2.)

THE BELTED BULL AND SOME OF THE HEIFERS USED IN THESE CROSSBREEDING EXPERIMENTS

Significant results in crossing Belted Cattle with Pied cattle were obtained by Mr. Houwink in his breeding experiments at Meppel, Holland. The bull was belted and all of the heifers were piebald. Of 55 calves born, 27 were belted, 25 were solid colored, and 3 were pied. Of the belted ones, only a few had the true pattern of the sire. Figure 2 illustrates the transmission of the various characters. (Fig. 3.)

IN PURE BREEDING OF BELTED CATTLE BLACK OR RED CALVES SOMETIMES RESULT

In 1918 one black calf and four belted ones were produced from the matings of the Lakenvelder or Dutch Belted Bull, Albert Wassenaar, with five cows of his own breed. The diagram illustrates both sides of the calves with the cows above them, and the bull at the top. (Fig. 4.)

SOME MORE PIEBALD HEIFERS USED IN THE CROSSBREEDING EXPERIMENTS

There were more than 60 piebald heifers used in the crossing experiments with the belted bull pictured in the herd on the opposite page. Six of the heifers were red and white, but the rest were black and white. The coat color inheritance is illustrated by the types shown in Figure 2. (Fig. 5.)

black around the eyes, a so-called Groninger "Zwartblaard" cow. Fig. 2 shows some specimens together with their calves. Of 54 of these animals the outcome of calving could be stated: 55 calves were born; of these 27 bore the belt character, 24 or 25 were self-colored, and 3 or 4 pied. Among the belted ones I found only a few with the true pattern like the sire. Nearly all of them had at any rate two white hind feet. (Figs. 6 and 7.) In some cases they showed worse deviations. Of these some will be seen in Fig. 8 A-C.

The self-colored ones were, as a rule, coal-black, but there were some among them that showed a small white spot on the belly, the tail-end or on the forehead. Still these animals were quite distinct from even the darkest specimens of pied cattle. Only in one case, which I have not been able to examine personally, was it doubtful whether the animal was to be set down as self-colored or pied; hence the figures as cited above. They were all of them black-haired calves (instead of red), proving that the bull was homozygous with respect to black hair. The "blaarkop" cow (white face with black around the eyes) produced a belted calf with a head like its mother. (See Fig. 2.)

Also the cross—piebald bull x belted cows—has been carried out in Holland of late years by Mr. Jochems at Wassenaar. There, too, the calves showed the three types, the proportion, however, being entirely different, viz., 18 belted, 2 self-colored, and 1 piebald. But we shall see presently that the various cows used in these experiments were probably partly homozygous and partly heterozygous

ONE OF THE TWO COMMON TYPES OF CALVES PRODUCED

The white belt pattern which is such a striking feature of the Belted cattle is entirely absent in this type of calf. Yet this type is commonly produced, even when both parents are belted. They occur less frequently, however, when the belted cattle are bred true for a considerable length of time, and more frequently after the introduction of fresh blood. (Fig. 6.)

toward the belted pattern, whereas the bull in Mr. Houwink's experiment was undoubtedly heterozygous. For these reasons we cannot draw any inferences relative to Mr. Jochems' breeding.

IRREGULAR COLOR PATTERNS

A very notable feature of the calves thus produced, however, is that for the greater part they showed very serious pattern deviations. This phenomenon is of frequent occurrence, which was corroborated by the additional evidence produced by Mr. *Van* Muilwijk, Secretary to the Herd-book of Belted Cattle at *Leerdam*. When such an irregularly belted animal, that is F_1 from belt X pied, is crossed back with a pied one, its calf is often more purely belted than the parent. We may therefore suppose that the pattern deviation is at least to some extent a modification. Further statements which I have set forth more in detail in *Genetica* confirm my experiences.

Of the cross belt X black only a few cases are known to me with certainty. From this cross I am not yet acquainted with the occurrence of pied calves.

It remains for us to consider the cross, black X black, black X belt, and black X pied, as well as their reciprocal crosses. It is not until this has been done that a supposition can be made with any amount of certainty concerning the genetic composition of our breeds. Everybody knows, however, that in practice it is often very difficult to carry out experiments with cattle. For this reason I shall not wait until such time as the other experiments should have been carried out, but proceed to set forth what is to be considered probable on the ground of what we know at present.

THE MOST COMMON TYPE OF CALF

This type and the one shown on the opposite page are the most common types produced by mating a heterozygous Belted bull with piebald cows. The coat pattern possessed by these cattle is of no commercial importance. Breeding to get the desired pattern has produced a decline in the general output of the animals. The above illustration is from an original photograph which unfortunately was so dim that retouching was necessary to bring out the details. (Fig. 7.)

GENETIC COMPOSITION

The breeding of Belted Cattle has of late years come to be disregarded in Holland. Only a very limited number of breeders have kept up this breed, and then mostly as "Park Cattle" (ornamental cattle). The complaint has frequently been made that owing to breeding with the exclusive view of obtaining the desired pattern, the general appearance and output of the animals was declining. Hence breeders often tried to improve these defects by the infusion of blood from a pied strain. This could be done, because the belt character is dominant or prepotent, as it is called. Thus it is not too bold to assume that Belted Cattle are to a not inconsiderable extent heterozygous as regards the belt character. The pied cattle which are bred thoroughly pure are undoubtedly homozygous as regards the piebald factor.

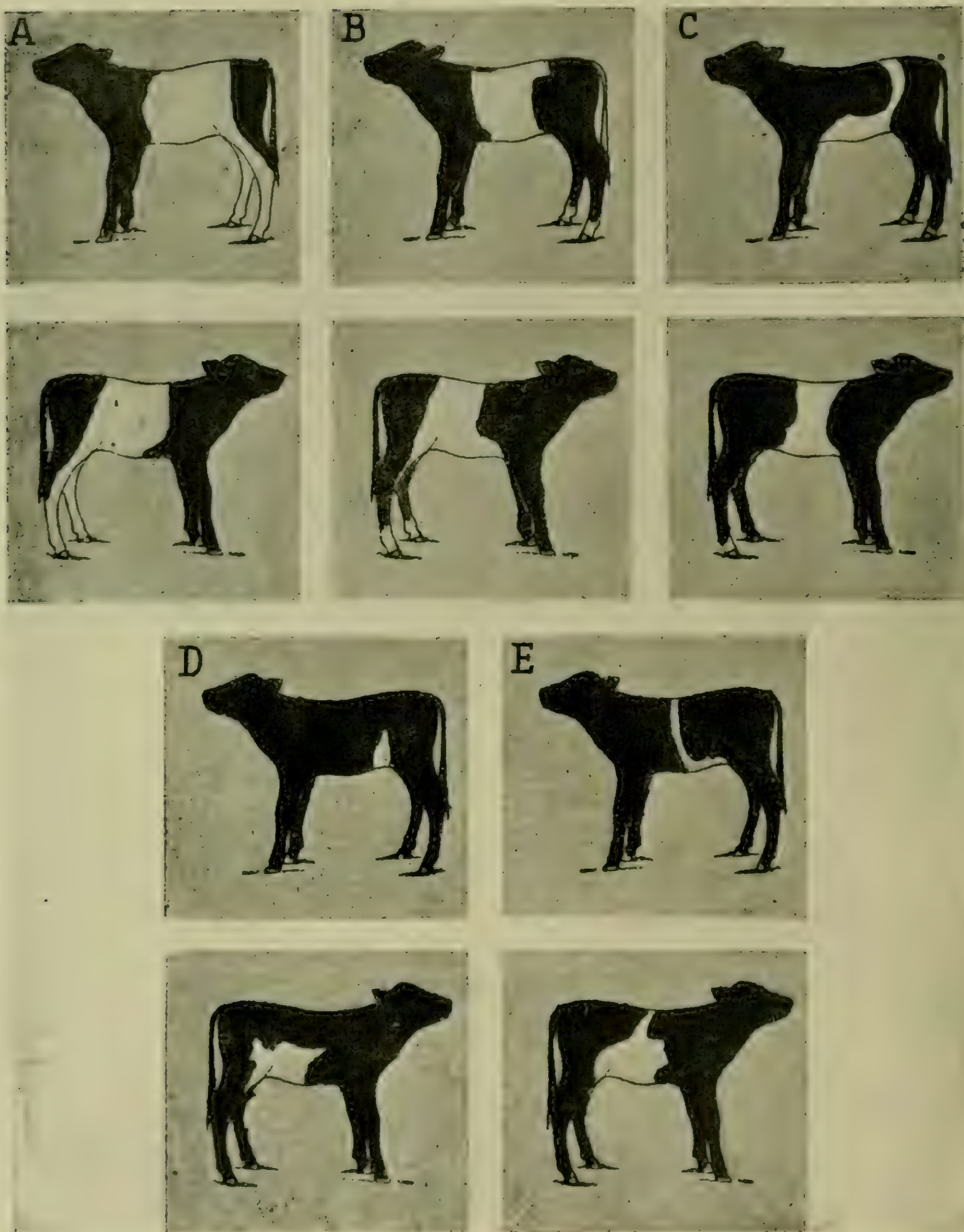
In explaining our experiment with the heifers I assume, therefore, that the heifers formed a homogeneous population as far as this factor is concerned, while the bull is to be considered heterozygous. Seeing that Mr. Jochems found the sire and the grandsire of this animal to produce plain black calves when purebred, this assumption is not hazardous.

Let us now assume two pairs of factors, viz.:

B = belt. . . . . . b = absence of belt

S = self-colored. . . . s = not self-colored: piebald pattern.

The numerical relation resulting from the experiment may be accounted for by assuming a repulsion between the factors B and S in accordance with the reduplication series, 1:7:7:1. If our bull answers to the formula, BbSs, he forms gametes in the proportion of 1BS:7Bs:7bS:lbs.



EXTREME DEVIATIONS OF THE BELTED PATTERN

A number of calves produced by the cross between a belted bull and piebald cows did not show typical patterns. The above diagram illustrates some of the extreme variations. The first three (A–C, the upper and lower illustrations showing the two sides) are considered as belted, and the other two (D–E) are modified black or piebald calves. (Fig. 8.)

When these are mated with the gametes bs of the pied cows (all of which have the zygotic composition bbss), the result will be:

1BsSs:7Bbss:7bbSs:1bbss or 8 belted: 7 self-colored: 1 pied.

Out of 55 calves this will yield: $27\frac{1}{2}$ belted: $24\frac{1}{16}$ self-colored: $3\frac{7}{16}$ pied. So the correspondence with the actual results is striking.

Let me add here that we are only dealing with a hypothesis, the correctness of which further investigations may either prove or disprove. There is one difficulty about it, namely this, that self-color should have to dominate over pied, while with various breeds the reverse is actually the case. But as we saw at the outset, similar variations of dominance are not infrequent in cattle.

If the repulsion of factors actually exists, the breeding of Belted Cattle of the formula BbSs with each other will yield: 1BBSS: 14BBSs: 49BBss: 14-BbSS: 100BbSs: 14Bbss: 49bbSS: 14bbSs: 1bbss; i.e., 192 belted, 63 self-colored, 1 pied. Practically speaking, therefore, pied will not crop up. The number of BB animals is frequent enough to account for the fact that in breeding stations where for years together only Belted Cattle are bred, self-colored calves are no longer found.

In addition to the hypotheses above I would offer the suggestion that the animals Bb (or BB) ss show a deviation from the belt. The fact is that in crossing Belt X Pied the great majority of the belted calves show deviations from the pattern, and in pure breeding, too, these deviations are quite frequent. Besides this, however, modifiers seems to play a part, as I observed above. It would lead me too far, if I were to set forth by what facts this supposition is supported. It is a matter of fact, however, that many cases from practical experience are explained by it.

Let me state in conclusion that by the study of herd books and by skimming through the American Journal, Dutch Belted Cattle, Bulletin and Live Stock Journal, published by the D.B.C. Association of America, I have found that a very high correlation, viz. 0.84 exists between the occurrence of white feet and too broad a belt. This is a phenomenon that is of high importance from a phenogenetic point of view, and requires further investigation.

It is obvious that the results obtained so far form only a step towards the solution of the difficulties, which are still an obstacle in attempting to account for the phenomena in connection with color and pattern in cattle. I hope to be able to come back to these questions when additional data are at hand. There may be American breeders of Dutch Belted Cattle who can contribute towards the problem by communicating their experiences.

The Child, Before and After

The Principles of Ante-Natal and Post-Natal Physiology, pure and applied. By W. M. Feldman, M.B., B.S., asst. physician to and lecturer on child physiology at the Infants' Hospital. With 6 plates and 129 illustrations. Pp. 694. London, Longmans, Green and Co., 1920.

In this monumental work, Dr. Feldman has brought together a mass of data dealing with the ways in which the child differs biologically from the adult. By way of introduction some 60 pages are devoted to the germ-plasm and the mechanism of heredity, while the mechanics of development occupy as much more space. The volume will be indispensable to any one working in the field of which it treats, since here for the first time is a review of the work done all over the world in an important and interesting phase of physiology.—P. P.

CITY AND COUNTRY

Effects of Human Environments on the Progress of Civilization

O. F. Cook

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ADVANCEMENT of the working-farmer has been the distinctive feature of our American system of agriculture, and of our national progress. Civilization in many countries could be described as superficial and parasitic, in being limited to a dominant class, with a primitive peasantry doing the agricultural work, as in China and in many parts of Europe. "From time immemorial to the present day the lot of the Egyptian peasant has been to work and to starve that those above him might live daintily," but such inequality is not consistent with "the free institutions of Western Civilization." The Western idea is that work should be shared, while Orientals take it as normal that some should live without bodily exertion, and form a superior class or stratum of society. A life of leisure and repose is an Oriental ideal, but repugnant to Western instincts of activity and fair play. Even our women have revolted against the Oriental tendencies and claimed their share of labor and responsibility.

A nation of progressive, independent, "small" farmers, tilling their own land with the help of their families and neighbors, has been our ideal in America, not a landed aristocracy conducting large estates, nor tenants farming for urban proprietors. Feudal tendencies have been resisted, but now agriculture is side-tracked by urban industrialism. Urban preferences and exactions are carried to extremes that discourage farming and endanger the production of food and industrial raw materials. Hunger and idleness of urban populations are in prospect. The farmer is patronized, commiserated and exhorted to persevere, because production is necessary, but it is the urban interest that speaks, not the spirit of rural progress. Urban ideas and ideals prevail, even among those who are concerned about agriculture, and farmers themselves are misled by urban prepossessions.

FINANCIERS MISUNDERSTAND FARMING

The notion that agriculture is about to be transformed by urban capital keeps many intelligent people from sensing the real problems. Millions of dollars spent in futile efforts to project urban ideas into agriculture show how farming is misunderstood in the city, even among financiers and "captains of industry." Although many of the large undertakings do not go beyond the stock-selling stage, and others are short-lived, there is a persistent belief that farming should be done in big units,

Note: The force of generalizations in any of the extremely complicated matters pertaining to our civilization depends so much upon the opportunities and abilities of the one who makes them that it may not be out of place to point out to the readers of the Journal that the author of this paper, who has already contributed several articles on this general subject, has had unusual opportunities to study and understand the reactions of living things to their environment. Mr. Cook's intensive early studies of one of the strangest of all groups of creatures, the Myriopods, which made him an authority on this classification; his investigations of the slime moulds and the termites, and later his systematic studies of that difficult group of plants—the palms—and the behavior in plantations of the coffee, the cacao and the Central American rubber tree, which involved a close study of their structure and variations, and his late years spent in studying the acclimatization phenomena connected with cotton breeding and selection, have put him in peculiarly close touch with the reactions of plants and insects towards their environment. These experiences, together with his early years of work in Liberia among the West African negroes, his investigations of the ancient and present primitive agriculture in Central America and Peru, his studies of agriculture in Palestine and Egypt, and his recent glimpses of the ancient agriculture of China, should give to his discussion more weight than is given to the words of a mere writer on general subjects. This discussion is being presented in two parts, the second of which will appear in the following number of the Journal. The italics are the Editor's.—Editor.

by labor-gangs or factory organization, in order to apply "modern business principles." The urban investor is convinced by arguments drawn from one-crop systems of agriculture where factory methods are approximated. On many tropical sugar plantations the workers are crowded into little slums as abject as any in towns. Countries that have an abundance of low-priced labor are more attractive to urban capital than farm projects in the United States.

One-crop systems of agriculture accord with the doctrine of producing in the cheapest place, and involve a maximum of commercial activity and urban profit, through the various operations of assembling, transporting and distributing. Selling farm produce to farmers who could grow the same things for their own use is much like carrying coals to Newcastle, but such business has developed to an enormous extent. Instead of the primitive commercial relations of farmers who planted mainly to supply their own needs, and carried only their surplus to market, some branches of agriculture are as completely commercialized as any urban industry. Before the boll-weevil came there were many farmers who grew nothing but cotton and bought all their supplies from the merchant. When necessity compelled such cotton-growers to produce their own food, and the change proved advantageous, they condemned the former one-crop system as an agency of oppression and a drag on rural progress, even to the extent of declaring the boll-weevil "a blessing in disguise."

AGRICULTURE IMPROVED BY SCIENCE AND CO-OPERATIVE EFFORT

Endless improvements of agriculture, not even suspected in the past, are being made possible through applications of science, not only in breeding better varieties of animals and plants, and devising superior cultural methods, but through social adjustments. In the cotton industry, for example, so simple an expedient as adherence of the farmers of a community to a single superior variety makes it possible to reach a much higher plane of productive efficiency and market advantage. One-variety communities can maintain and utilize well-selected, uniform types of cotton, instead of the irregular, mongrel stocks that result from mixture of seed at public gins and cross-pollination in the fields. One-variety cotton communities in irrigated valleys of the Southwest have altered in a few years the agricultural status and prospects of development of this quarter of the United States.

Much may be hoped from new forms of co-operation that are being devised in agricultural communities, which urban interests would do well to recognize and promote, if possible, instead of opposing. Undoubtedly the farmers must study marketing and other problems of rural welfare for themselves, if satisfactory solutions are to be expected. The conspicuous success of co-operative enterprises among the farmers of Denmark has encouraged similar efforts in many countries. California has 93 agricultural organizations, and it is claimed that more than half the farmers now sell their products through co-operative marketing associations, which are extending rapidly. It is not to be expected that urban policies of exploitation can be changed at once from courses followed so long, and from traditions so firmly established, but the general need of better relations of urban and rural interests must be appreciated, as a basis of constructive co-operation. A spirit of good will and fair play is necessary to see the many sides of practical questions, as well as unlimited patience in considering and testing alternative plans.

FARM LIFE IS VARIED AND COMPLEX

Urban reformers of agriculture need first of all to understand that normally diversified farming is much more complex and harder to learn than any specialized trade or occupation of the city. The work of the farm is a combination of many different arts and operations that require endless fitting and readjustment to meet continually

varied conditions. Neither the theory nor the practice of agriculture can be reduced to the simple system or prescribed routine of an industrial operation. The farmer knows by experience how the soils vary, even in parts of the same field, and that every season brings new combinations of conditions. Each variety of plant, each breed of animals is different, with special habits and qualities that capable farmers recognize and take into account, as affecting production, home uses, and market requirements.

Farmers have perennial novelty and interest in their work, and thus are able to live without the artificial "pleasures" that city people crave as a relief from the monotony of a routine existence. The urban idea of agriculture, as a kind of serfdom or privation that needs to be alleviated, takes no account of the more normal functions and deeper satisfactions of rural life. The true urbanite does not understand why anybody would stay in the country and do farm work, except under compulsion. He would not think of living or of taking his family to a farm home that lacked the domestic conveniences of light, heat, running water, baths and sewage disposal, as provided in modern cities. Although it is easier to have "modern improvements" in city houses, this does not justify neglect of health and comfort in farm homes, unless farm people are to be reckoned as an inferior or peasant class, as in foreign countries. Painful contrasts are often to be noticed between the many good houses in towns, and the few comfortable homes in the surrounding country, even in rich agricultural districts. Such disparity is an alarming portent to all who believe with Roosevelt, that "our civilization rests at bottom on the wholesomeness, the attractiveness, and the completeness, as well as the prosperity, of life in the country."

Farming is facilitated by modern implements, in the sense that fewer men are required, but running complicated machines and keeping them in repair is harder and more exacting work than the old hand labor. Certainly the conditions and comforts of farm life have not improved in proportion to the use of machinery. The chief social effect of "labor-saving" inventions thus far is that more people find ways to retire from the work of production and live in idleness, or engage in nonproductive urban activities. It seems natural to city people to be supported by others, and furnished with luxuries and amusements. Lightening the load of labor has begun with the shorter hours that urban workers of Europe and America have secured, but farming still is done on the "Can to Can't" system, as they say in Texas, "from the time when you can see to the time when you can't." The use of machinery has not brought the "universal opulence" and "general plenty" that were to diffuse through the machine-using nations, according to the prophecy of Adam Smith in the famous chapter on division of labor, in "The Wealth of Nations." If the true cost of a thing is the amount of life that must be exchanged for it, our industrial system is very imperfect. Some find themselves compelled to work all their lives without getting a living, while others are deprived of work and discontented from having nothing to do.

Leisure as well as wealth must be shared by the city with the country, to afford equal opportunities of progress. Freedom from too continuous labor is necessary to give us time to see and think, to cultivate the fields of science and develop the arts. The urban prepossessions of our educational systems need especially to be challenged and displaced, before our minds can be liberated to think constructively about agriculture or other fundamental problems. Factory methods are out of place in education no less than in farming. Education is over-grown as a system, but poorly developed as an art. *Children need full contacts with nature and with parents and grandparents as in the life of the farm*, instead of being bulked and graded mechanically with other children of the same age for formal instruction in schools. *The world of plants and animals is the*

normal environment of the child, while the senses and judgment are trained by sharing the varied work and responsibility of the farm. The capable mind reflects the diversity of nature, and gradually takes over the accumulated experience of preceding generations. Knowing comes largely from doing. The hand is the instrument of intelligence that teaches the brain the relation of cause and effect, which is the basis of practical thinking and of scientific progress. Thus agriculture has fundamental educational values that are entirely overlooked in urban institutions.

Although the importance of agriculture is admitted by every thoughtful person, the conventional attitude of our "educated class" is negative and aloof, like the Chinese literati who think of farming as "coolie work." Literature has flourished in China for many centuries, but the wonderfully specialized systems of agriculture have not been appreciated or described. "People who know about agriculture don't write books, and those who write books don't know about agriculture," was the explanation that an eminent Chinese scholar gave me. Chinese literature and art reflected a higher appreciation of nature and out-door life several centuries ago than in the present age of urban degeneration and decay. Neither have the literary and educational talents of our race been applied to agriculture. Works of reference we have, but few books that can be read for pleasure or contemplation of ideals. The synthesis of intellectual and agricultural life is still to be made.

WHERE IS THE "HIGHER EDUCATION"?

False notions of the educational "advantages" of cities are among the most effective forms of urban propaganda, and lead thousands of families every year to leave their farms. Short-term rural schools are assumed to be inferior, without considering the value of farm conditions for normal development of children. Urban environments tend to dehumanize by leaving many of the normal instincts unsatisfied and energies suppressed. *A narrow urban existence is a privation of life that no child should suffer, and that no parents would inflict, if the facts were appreciated.* Those who grow up without the experience of farm life are not at home in the world. No amount of urban education can take the place of farm contacts in the development of constructive intelligence.

That town children are kept in school ten months in the year is no reason why farm children should be herded together or shut up with books for the same length of time. The urban need of sending even the very young children to school to keep them out of the streets does not exist in good country homes. The theory of division of labor is carried to many injurious extremes in the city schools, as though the object were to restrict the abilities of the children to a low average of mediocrity. The factory system dominates the school system, and "higher education" is still "semimonastic." In order to be made intelligent we become inept, through long periods of seclusion from work and tangible responsibility, in our so-called "institutions of learning." Shorter periods of formal instruction, not breaking our contacts with life, nor surfeiting our minds, would leave us with better appreciation of practical knowledge and more constructive social interest.

Instead of people being educated apart, to serve in institutions or to live by their wits, *the arts of production should be as highly developed and as much appreciated as the arts of expression and exploitation.* Little has been gained as yet by adding courses in agriculture to our system of formal instruction. Even our professedly agricultural colleges are training the students for urban occupations, rather than for farm life. To judge from the present agricultural courses, farmers are supposed to have only a narrow and casual interest in the world at large, whereas the intelligent farmer, living a normal life and raising a normal family, usually has a more active interest than the urban business man in

knowing the past and foreseeing the future of human progress!

Having ascertained that our institutional system is not a congenial stock for agricultural education, we should be ready to try the alternative experiment, to see how much education can be grafted on agriculture. The methods that are being developed to extend the use of special agricultural and household information among farmers could be applied to the diffusion of knowledge of other kinds, and make it possible to determine the true possibilities of rural education. Not only the feeding and care of infants, but the nurture of older children can be learned by parents if the need is recognized, instead of the schools assuming responsibilities that they are unable to meet.

Not only in education, but in many other ways, the habitual acceptance of urban ideas interferes with the concrete biological, human-interest study that farm problems need. *Agriculture must be set in the midst of the world's thought,* not merely taken for granted, or given only casual, peripheral attention. Reflecting that agriculture is the basis of our existence will not maintain our civilization if farm life is submerged and smothered by urban superfluities.

FARM PROBLEMS NEED PERSISTENT STUDY

Instead of waiting blindly for abstract "economic principles" to determine the fate of our civilization, as of others in the past, we should see that practical adjustments of human relations and activities need to be worked out with the same scientific patience and precaution as the development of flying-machines or other difficult inventions. Gravitation and equilibrium offered many baffling problems, but did not make flying-machines impossible. No such intensive consideration has been given to human welfare adjustments as to mechanical devices, military tactics and strategy, or to industrial and commercial systems. Theology and astronomy have absorbed more high-power intelligence than the scientific study of agriculture or of human progress.

Farmers, no less than scientific investigators or business experts, need time and opportunity to discuss, organize, and develop constructive ideas. "Farming is a job that requires the best brains of the best men, for no country has ever solved its agricultural problem." But the urban problem of making money out of the farmers has had many ingenious and effective solutions, reached by persistent study. Beyond the urban horizon are the farm problems, as wide and many-sided as civilization itself, which essentially is an outgrowth or epiphenomenon of agriculture. A true, agricultural civilization would provide for a full development of human instincts and abilities, while urbanism permits only a partial, restricted development. Hence, *urbanism is to be distinguished from civilization, and avoided like a disease.*

Instead of being concerned with civilization as a highly complex organization of human activities, much of our so-called "political economy" is mere formulation of urban interest—the science of wealth, but not the study of welfare. Discussion usually is entangled in abstract definitions and deductions, or interest is diverted to moral or political "principles," instead of facing the issues of agricultural progress. Many economic writers consider only commerce and finance, while others treat of land as a form of property, or of crop production as affecting industry and taxation, but not of agriculture as a *human environment,* a fundamental condition of the life, liberty, and progress of civilized people. There is warrant for the critic who says: "I get the impression from books on political economy that most writers and readers first dehumanize themselves as a prerequisite to a discussion of the morals of trade." Economists are not eugenists. They do not use the "Man-Measure" of the ancient Greeks, nor regard the poet's warning, "Where wealth accumulates, and men decay."

LAND-HUNGER OF FARMERS

Not abstract reasoning, but concrete perceptions of the relations of agriculture to other forms of human activity are needed. No doubt it was the economic classification of agriculture as an "industry," along with urban occupations, that led Karl Marx and Henry George to deduce their belief that private ownership of land should be abolished and production controlled by the State, in order to cure urban poverty and degeneration. Socialism and the single-tax are urban theories, and have the wrong psychology in relation to agriculture. George argued, of course, that his single tax program would encourage farming by making land more readily available, and that the farmer's "main interest is that of a producer, not that of a landowner," but farmers are not attracted by "the idea of virtually making land common property," or of becoming tenants on public lands controlled by urban officials. A more subversive proposal could hardly be aimed against our system of civilization than that of taking land away from farmers and treating it as public property, to be managed from the city.

Many primitive civilizations have developed without land-ownership, but none of the more advanced civilizations. The land-hunger of the farmer is a normal and beneficial instinct closely related to other constructive and home-making instincts, and of fundamental importance in developing and maintaining civilization. If the city man "fights better for a home than for a boarding-house," so the farmer will fight better for his own land than for a tenant holding, and has more interest to maintain the fertility of the soil and add permanent improvements. What advantage could come to the city by making the farmer less interested in his work, or in his home and surroundings? The proposal of Marx, that agriculture be carried on by the forced labor of "industrial armies," shows the nature of his interest and information of the subject. The urban reformers do not see the fundamental difference between the rural use of land and the abuses that arise from urban control of land and exploitation of agriculture. Instead of seeking for constructive improvements of our land tenure system, socialism proposes to abolish at once all of the customs and institutions of private property, with only chaos to expect, as in Russia, where the original Marxian theory is being applied. Socialism appeals to the proletariat through the misery-loves-company feeling, the *Schadenfreude* of the Germans, who specialize on this sentiment. It comforts the deprived to believe that the rest of the world is coming rapidly to the same estate, and that the whole system of existing civilization is soon to be destroyed by a grand international upheaval.

Marx dwelt upon the tendency of centralized industrial systems to class conflicts, and eventually to urban proletariat control, but before that stage can be reached in America our farming population must give place to a passive rural peasantry, as in Russia and Central Europe. That the urban proletariat will know how to restore agriculture after our present industrial system has decayed, seems a vain hope. Sending out soldiers to raid the peasants may be the only way to get food for the Russian cities, but certainly is a poor way to get more crops raised! Agriculture must be wrecked as well as the urban industries, in order to "get free and begin over."

Conservatism is not the chief obstacle to agricultural progress, but lack of the *enlightened interest* that would find practical solutions of the problems. Paths that are once opened may be followed to any length, but new paths require careful seeking. Each of the nations finds problems of its own, in attempting to escape from conventional ideas and systems. In France extra burdens are laid upon agriculture by the habit of subdividing land into small parcels, 150 million parcels and less than 9 million owners, according to a recent report. It is easier to see the

disadvantages of such a system than to work out a readjustment. Other countries have the problem of large holdings that need to be broken up, for the same motive of national interest in rural welfare. "France must engender again in the minds of her agricultural population—love for the native soil, and the determination to find upon it the secret of a happy, useful, and prosperous existence."

A Case of Heredity vs. Environment

Heredity and Social Fitness: A Study of Differential Mating in a Pennsylvania Family, by Dr. Wilhelmine E. Key, Eugenics Record Office, Carnegie Institution of Washington, Publication No. 296, Carnegie Institution of Washington, 1920. 102 pages, 2 figures, 2 charts.

An intensive study of the descendants of two families of German immigrants who settled in a certain region in western Pennsylvania toward the end of the 18th century, and who have been found to be the connecting link between a great many of the deficient individuals living now in this region. The special traits and general social fitness of each individual for six generations is brought out by their position in life, the opinions of neighbors, anecdotes, institutional records, etc.

Certain lines of descent gradually rose in the social scale while in others, defectiveness became more and more concentrated. There was a marked tendency toward segregation in particular lines, of particular types of deficiency, such as lack of aggressiveness, perseverance, or calculating ability. Heredity is considered to be in the main responsible for the low social level of each family network as a whole and for the differences between different lines. Environment is considered a factor but a relatively unimportant one in the rural community in which all elements of the population mingled freely in school, church and social life. Considerable direct evidence, moreover, indicated the ineffectiveness of good environment with respect to poor stock and the reverse. It is noted, however, that there was a marked tendency for the superior members of the families to leave the region, in some cases expressly to escape the stigma which attached to their family names. Marriage selection was a very important factor in the concentration of social inefficiency. This concentration appears to be the precursor of elimination of the worst lines through heavy child mortality and segregation in institutions.

The study furnishes a vivid and convincing picture of the play of factors which result in socially injurious family complexes.—S. W.

Farming Risks Greatest in the Plains States

Risks in the production of three great staple crops—corn, wheat, and oats—are greatest in the Plains States extending from Texas to North Dakota. This general fact is established by the average deviation of the yield per acre from the average yield, computed by the Bureau of Crop Estimates, United States Department of Agriculture, for these three crops for each State from the records of 50 years.

On the other hand, the North Atlantic and the Western States are regions of comparatively low risk, or deviation of yield per acre from the average, for wheat and oats, and the entire Atlantic coast and the West for corn.

The great corn belt, with its enormous production and surplus above local consumption, is, after all, prominently subject to risks of weather, insects, and disease in the production of crops, and, while it would be going too far to say of this region as a whole that the results of its agriculture are either "a feast or a famine," yet there is a tendency in this direction as the area covered by the average becomes more restricted to county, township, and individual farm.—*Weekly News Letter*, U. S. Dept. of Agri.

INHERITANCE OF SILKINESS IN FOWLS[1]

History and Description of the Sporadic Occurrence of Silky Feathered Birds Among Normally Feathered Ones, and Their Relation

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IN THE summer of 1917 the writer's attention was called to a hen (No. 1A in Fig. 9), chiefly of unpedigreed Brown Leghorn breeding, judging by appearance, but with plumage resembling that of the Silky Fowl. The individuals of the flock from which she came were normally-feathered, scrub fowls resembling Brown Leghorns and Rhode Island Reds. The appearance of such an unusual individual was particularly interesting, since so far as the owner knew there was no Silky blood in the flock. It seems, furthermore, unlikely that a fancy breed like the Silky would ever have been used in the establishment of such a utility flock.

A casual examination of this bird (1A, Fig. 9) showed the body covered with down-like feathers, resembling those of the true Silky. According to Tegetmeier (1873, p. 45) the silky condition is due to the lack of hooks on the barbules, and this has been confirmed by examination of wing coverts from 1A and from a pure bred Silky cock (4A). The same condition was found to obtain in the down feathers of a normal White Rock hen and in the basal fluff of the ordinary contour feathers. Silkiness is therefore normally present to this extent in all birds, but is developed to the extreme in these abnormal cases. In 1A the flight and tail feathers were badly frayed, the shafts appearing almost bare.

This abnormal condition of the flight feathers of 1A obviously made a close comparison of them with the corresponding feathers of individuals of the breed of Silky Fowl impossible. A comparison of the degrees of silkiness of the wing coverts obtaining in the four birds showed many of 1A's to be normal as were also those of the purebred Silky cock 20A, while all of the wing coverts of 4A and 5A were silky.

The plumage structure of 1A was her only resemblance to individuals of the Silky breed since she lacked blue or black skin, a topknot, rose comb, feathers on her legs and presumably supernumerary toes,[2] which features are as characteristic of the standard Silky Fowl as is the peculiar feather structure.

TRUE VARIETIES OF THE SILKY FOWL AND THE SPORADIC OCCURRENCE OF SILKY FEATHERED BIRDS AMONG NORMALLY FEATHERED ONES

The Silky Fowl, according to Davenport (1906), dates back to the thirteenth century when Marco Polo is said to have observed it in Asia. Davenport (1906) and Tegetmeier (1873) both state that Gessner described it about 1555. Taubert (1910), however, mentions no descriptions of this breed of poultry earlier than that of Aldrovandus in 1597. Taubert also gives a historical sketch of the modern Silky Fowl up to the present time. Suffice it to say for present purposes, however, that breeds and individuals with the so-called silky plumage have been described by old and modern writers on poultry.

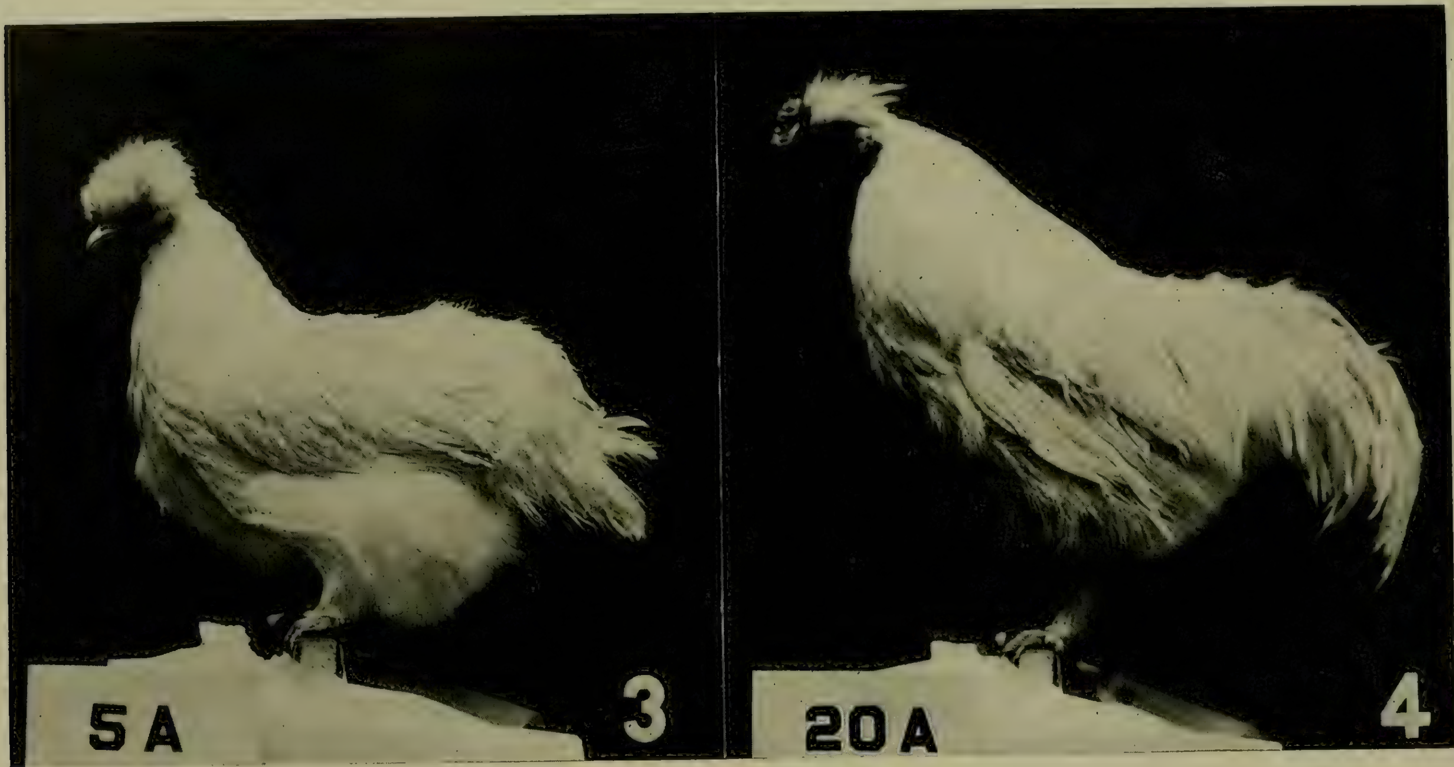
[1] Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 27. Published with the approval of the Director of the Station.
[2] This bird's toes had been frozen off before she was obtained.

The writer wishes to express her gratitude to Professor L. J. Cole for his helpful suggestions, and to Professor J. G. Halpin and Mr. O. N. Johnson of the Poultry Department of this Station, not only for the use of incubators and brooders necessary for carrying on the breeding work above described, but also for their personal assistance.

A SILKY FEATHERED BIRD FROM A SCRUB FLOCK COMPARED TO A BIRD OF THE TRUE SILKY BREED

The Silky breed of fowl gets its name from the peculiar silky character of its feathers. The breed has been known as far back as the thirteenth Century. Its plumage resembles the downy condition common to all birds when young, or as though the feathers of a normal bird had become badly frayed. The condition is due to "the lack of hooks on the barbules"—the process fringing the barb of a feather. Occasionally a bird with silky feathers is found among a flock of normally feathered ones. The bird shown at the left occurred unexpectedly in 1917 in a common farm flock of normally feathered fowls resembling Brown Leghorns and Rhode Island Reds. She herself appeared to be of Brown Leghorn breeding but her feathers resembled those of the Silky Fowl. No other character of the Silky Fowl, however, was present.

The bird at the right (5A) is a purebred Silky hen, a typical representative of the standard breed of Silky Fowls. Note the different condition of the barbs on this hen compared with those of 1A. (Fig. 9.)



TYPICAL REPRESENTATIVES OF THE SILKY BREED

The hen at the left (5A) is another view of the one shown at the right on the preceding page. No. 20A, at the right above, is a representative cock of the Silky breed. In addition to the silky feathers this breed is characterized by a blue or black skin, a topknot, rose comb, feathers on the legs, and supernumerary toes. It is a fancy breed and not used in building utility flocks. Although the standard Silky Fowl has white feathers and a dark skin, there are several varieties possessing various other colors of skin and plumage. (Fig. 10.)

FIRST GENERATION CROSSBREDS BETWEEN SILKY AND NORMAL FEATHERED FOWLS

Several experiments have been conducted in crossing purebred Silky fowls with birds of normal plumage, but no studies seem to have been made to determine the inheritance or genetic behavior of the plumage of those Silkies which have occurred in other standard breeds.

The bird at the left above is a first generation hen from a cross of the sporadic silky hen 1A (in Fig. 9) with a normally feathered White Leghorn cock. The plumage is normal, as was also that of the other two individuals produced from this mating, thus illustrating the dominance of normal feathers over the silky character. The dishevelled appearance of some of its plumage is not due to abnormal feathering.

Another one of the first generation birds from this mating is shown at the right. This is a full brother of the hen shown at the left and, like her, has normal plumage. These birds also show the partial dominance of white as they are almost entirely white with pigmented flecks. (Fig. 11.)

Although the standard Silky breed comprises white feathered birds with dark skin, Beeck (1908) discusses five other varieties differing in various respects. The first is the Siamese Silky Fowl with black periosteum, red skin on the head, yellow legs and beak, and feathers with a yellowish cast. The second variety is the Japanese Silky, possessing a dark skin and white feathers like the standard Silky. The black bantam Silky of Japan which has a dark skin is the third variety described. The feather color of the fourth variety, known as the Chinese Silky, resembles that of the Siamese breed in being yellowish. The Negro Fowl, the last of the five varieties described, possesses both black skin and feathers. Wright (1891) quotes Blyth to the effect that some Silkies have single, red combs, some are clean legged and others feathered. Sturges (1909) describes black and also blue feathered Silkies. Descriptions of the Japanese, Siamese and Black Dwarf Silkies given in Brehm's Tierleben (1911, p. 67) correspond in the main to those of Beeck. Mention is also made of the variability of plumage color, which may be white, black or of other colors. The plumage of the Chinese Silky Fowl is said to be more wooly than straight and silky.

Since these birds may occur in almost any skin and feather color it is not surprising to find references to their sporadic occurrence among flocks of normally feathered individuals. Bement (1863) in describing the Silky Fowl says, "This is one of the accidental varieties that now and then break out in most yards.—We have known several instances of fowls of this description having sprung from those of the ordinary character." Robinson (1913) states that, "In all races of fowls individuals sometimes appear in which the web of the feather is of a peculiar formation resembling hair." In this connection Bement relates the following amusing anecdote. "This is the breed, which gave rise, in 1776, to the fable of the 'Rabbit fowl' which was exhibited in Brussels as the produce of a rabbit and a common hen, which was merely a Silky fowl of Japan." Bechstein is quoted in Brehm's Tierleben as having known certain itinerant showmen who, in fun, represented Silkies as hybrids between fowls and rabbits.

The foregoing statements are somewhat general and do not relate to specific breeds. Tegetmeier, on the other hand (1873, p. 45) in describing the Cochins discusses a silky variety of this breed which he says is "an accidental variation of plumage which occasionally occurs—." Wright (1891) also mentions the incidental occurrence of silky feathered individuals among Buff Cochins, remarking that such birds are yellow in color like their normally feathered relatives. Professor Lippincott of the Kansas State Agricultural College recently told the writer that he had observed two buff silky-feathered birds among apparently purebred Buff Cochin Bantams.[3]

Further information on this subject has been obtained directly from other poultrymen. A letter from Mr. Platt of the American Poultry Journal says he has seen silky specimens in a flock of Rhode Island Reds and also in a flock of Black Orpingtons. He adds that Klondykes and also Missouri Fluffs are varieties with silky plumage which suggest White Rock or White Wyandotte origin and Mr. Jackson of the Reliable Poultry Journal states that he "recalls seeing a very occasional bird of this type, and a few years ago found a well established flock in Northern Ohio, which originated from White Wyandottes. The birds still carried rose combs and were of good size and of about average quality as to Wyandotte type."

[3] Bateson (1894, p. 55) quotes from an article by Mr. J. H. Gurney in the Trans. Norwich Nat. Soc., III p. 581, concerning "hairy" varieties of the Moorhen (*Gallinula chloropus*). Twelve such specimens had been found in different parts of England and Ireland. "A few feathers of this kind have been found in Hawks and Gulls, and in the case of a *Parra* . . . ., a great portion of the body feathers were in this condition." The occurrence of a silky Grey Brahma hen is also mentioned.

Professor O. B. Kent of Cornell University states that according to poultry papers "silky Black Langshans were comparatively common in England." It is of interest to mention in this connection the very recent occurrence of such abnormally feathered birds in a flock of Langshans in the state of Missouri. The appearance of these birds was communicated to the American Poultry Journal, which, knowing the writer's interest in this subject, very courteously forwarded a copy of its answer. The statement is made that this is the first instance which has come to the American Poultry Journal of silky feathered birds appearing in this breed. Professor Kent also mentions the occasional occurrence of silkies in the flock of Rhode Island Reds at the Cornell Station. According to Professor Halpin of the Wisconsin Experiment Station the same breed at this station has also produced a silky or two.

Professor Kent further offers some information regarding an attempt to establish a breed of silkies called the Onondagas. These were bred by a poultryman in Syracuse, N. Y., from silky feathered Rhode Island Red females and a brown Leghorn male, also with silky plumage.

From the foregoing it appears, then, that silkiness occurs sporadically not only in scrub flocks of poultry, but also in the Cochin, Bantam Cochin, Rhode Island Red, Black Orpington, White Rock, White Wyandotte, Brown Leghorn, Gray Brahma and Black Langshan breeds.

LITERATURE ON THE INHERITANCE OF THE PLUMAGE OF THE SILKY FOWL

So far as the writer is aware, no study has been made of the genetic behavior of the plumage of sporadic silkies, but several experiments have been performed in crossing purebred Silkies with normal-plumaged birds.

According to Darwin (1868) the "Silk-fowl" breeds true, but when crossed on a bird with normal plumage the latter dominates. He speaks of Mr. Orton's obtaining three silky feathered birds "out of many reared" from a male Silky and a female Bantam. This would indicate that the female Bantam was heterozygous for silkiness.

The dominance of normal plumage over silky is further illustrated by Tegetmeier (1873) who speaks of crossing the latter with many breeds of poultry, when, as a rule, normal feathers result. He also states that a pair of birds from a Silky hen and Spanish cock produced one silky offspring.

Later work on such crosses has given more definite results. Davenport (1906) crossed the Silky with the Frizzle (the feathers of this breed being normal in structure but recurved). Silkiness proved to be recessive in the F_1. No data were given for the second generation but the statement is made later (1907) that when plain and silky feathered birds are crossed together all the resulting offspring have normal plumage and that 25% of the F_2's are silky.

The experiments performed by Bateson and Punnett (1908) furnish some figures showing the simple Mendelian behavior of the silky character. They crossed a Silky with a normal-plumaged fowl and obtained in the F_2 77 normals to 22 silkies, which is very close to the expectation of 74 to 25. In a backcross of an F_1 with a Silky 25 normals and 28 silkies were obtained, 25.5 of each being expected. Nothing is said regarding the character of the F_1 plumage but it is to be presumed that it was normal.

Further evidence, though very meager, is given by Cunningham (1912) on a cross of a normal-feathered Bankiva male and a Silky female. The number of resulting F_1's is not stated, but all are said to have had normal plumage. The numbers obtained in F_2 were small, being 7 normal to 3 silky.

Bonhote (1914) crossed a Silky cock with a Yokohama hen and obtained a pair of normal-plumaged F_1 offspring. These bred together gave 24 birds, 18

WING COVERTS FROM THREE PUREBRED SILKY FOWLS

Coverts are the feathers overlying the bases of the quills of a bird's wings and tail. Those shown above are from purebred Silkies; those of 4A and 5A were all entirely silky, as was also the majority of 20A's. The latter bird, however, had a few normal wing coverts. The birds 5A and 20A are shown in Fig. 10. (Fig. 12.)

Normal and silky wing coverts from the sporadic Silky hen 1A are shown at the left. (The hen 1A is shown at the left in Fig. 9.) The feather on the right has a hairy appearance due to the absence of hooked barbules. When these are present the feather assumes a normal appearance as shown by the left hand feather.

The bird at the right is an extracted second generation Silky hen, a full sister to 6 C shown in Fig. 15. (Fig. 13.)

A NORMALLY FEATHERED CROSSBRED HEN

This hen with normal feathers was the result of crossing the sporadic silky hen 1A (see Fig. 9) back to the latter's son 3K (Fig. 11). Silky feathered birds were also obtained from this cross. The ratio, as expected, was 1:1. (Fig. 14.)

with normal feathers and 6 with silky, which corresponds exactly to expectation.

A summation of the results of Bateson and Punnett, Cunningham, and Bonhote gives 102 normal-plumaged birds to 31 silky in the F_2 generation, the expectation on a 3:1 basis being 99.75 to 33.25. The character of the plumage of the purebred Silky Fowl is, then, obviously a simple Mendelian recessive.

RELATION OF THE SPORADIC SILKY'S PLUMAGE TO NORMAL PLUMAGE

In order to determine the relation of the plumage of 1A to that of normal plumage, this hen was crossed in 1917 with a purebred White Leghorn cock. The selection of this breed was entirely arbitrary. Of ten chicks hatched only three were successfully reared. One of them proved to be a cock and the other two hens. Their plumage was normal like that of their sire. Figures 5 and 6 show the F_1 cock and one of the hens. The ragged appearance of the hen's tail is due to a dishevelled condition and not to abnormal feather structure.

The following year an F_2 generation was obtained. The two birds just mentioned were mated and produced 40 chicks, 29 of which had normal plumage and 11 silky (30 to 10 expected). Two of the F_2 silkies are shown as Nos. 10 and 11 in Figs. 13 and 15. The other F_1 mating gave but 5 chicks on which feather condition could be determined. These all had normal plumage. Adding them to the above figures, the result gives 34

A SILKY BIRD FROM CROSSBRED PARENTS

This second generation cock is from the mating of the two first generation crossbreds (Nos. 5 and 6) shown in Fig. 11. One such silky bird to three normally feathered ones resulted from this mating, which shows the recessive nature of silkiness to normal plumage. Nos. 5 and 6, as has been stated, were obtained from crossing the sporadic silky hen 1A with a normally feathered White Leghorn cock. (Fig. 15.)

normals to 11 silkies, which is as close as possible to expectation (33.75: 11.25).

A backcross was made by mating 1A back to her son 3K (or No. 6 in Fig. 11). Twelve birds on which plumage condition could be told were reared; five of these had normal feathers and six silky, where equality was expected. One of the normally feathered individuals is shown in Fig. 14.

The preceding data on the relation of the plumage of the sporadic silky to that of normal plumage show it, like the plumage of the purebred Silky, to be a simple Mendelian recessive.

RELATION OF THE SPORADIC SILKY'S PLUMAGE TO THAT OF THE SILKY FOWL

The next step was to ascertain whether sporadic silkiness is caused by the same factor that produces silkiness in the purebred. To initiate such a test reciprocal crosses were made of purebred Silkies on purebred White

TABLE I. *Matings in Which 1:1 Ratios Are Expected*

Mating No.	Type of Mating	♂	Comp.	♀	Comp.	Obtained Normal	Obtained Silky	Expected Normal	Expected Silky	Dev.	P. E.	Dev. / P. E.
16	♂—F_1, normal, sporadic silky by White Leghorn ♀—Purebred Silky	3K	Ss	5A	ss	4	1	2.5	2.5	.60	.301	2.0
18	♂—F_2, silky, from sporadic silky by White Leghorn ♀—F_1, normal, from ♀ Silky by ♂ White Leghorn	6C	ss	12E	Ss	20	12	16	16	.25	.119	2.1
19	♂—F_2, silky, from sporadic silky by White Leghorn ♀—F_1, normal, from ♂ Silky by ♀ White Leghorn	6C	ss	15N	Ss	13	22	17.5	17.5	.26	.114	2.2
23	♂—F_1, normal, from ♀ Silky by ♂ White Leghorn ♀—F_2, silky, from sporadic silky by White Leghorn	12K	Ss	6E	ss	6	4	5	5	.20	.213	.95
25	♂—F_1, normal, from ♂ Silky by ♀ White Leghorn ♀—F_2, silky, from sporadic silky by White Leghorn	15B	Ss	$6N_2$	ss	16	10	13	13	.23	.113	1.7
26	♂—Purebred Silky ♀—Backcross, normal, from sporadic silky by White Leghorn	20A	ss	9Q	Ss	17	15	16	16	.06	.119	.5
27	♂—Purebred Silky ♀—F_1, normal, from sporadic silky by White Leghorn	20A	ss	3J	Ss	16	12	14	14	.14	.128	1.1
	Total					92	76	84	84	.10	.05	2.0

Leghorns. From the mating in which a Silky male was used, 22 normally feathered birds resulted and from the reciprocal 28, making a total of 50. This again shows the recessive nature of silkiness to normal plumage.

In the summer of 1919 various crosses were made of these F_1's with F_1's and F_2's from the sporadic-silky Leghorn cross. The results of such matings are given in Tables I and II. Table I shows those matings in which equal numbers of normally and silky feathered birds were expected, providing the silkiness of these two types of fowls is the same. Reference to column 2 (Table I) shows various combinations of extracted F_2 silkies from 1A, mated to F_1's from purebred silkies by Leghorns, and purebred Silkies mated to normal F_1 individuals resulting from the sporadic silky Leghorn cross. An excess of normally plumaged birds is obtained in all

TABLE II. *Matings in Which 3:1 Ratios Are Expected*

Mating No.	Type of Mating	♂	Comp.	♀	Comp.	Obtained		Expected		Dev.	P. E.	Dev. / P. E.
						Normal	Silky	Normal	Silky			
21	♂—F_1, normal, from sporadic silky by White Leghorn ♀—F_1, normal from ♀ Silky by ♂ White Leghorn	3K	Ss	12A	Ss	26	6	24	8	.25	.211	1.19
22	♂—F_1, normal, from sporadic silky by White Leghorn ♀—F_1, normal from ♂ Silky by ♀ White Leghorn	3K	Ss	15J	Ss	14	1	11.25	3.75	.75	.301	2.4
24	♂—F_1, normal, from ♀ Silky by ♂ White Leghorn ♀—F_1, normal, from sporadic silky by White Leghorn	12K	Ss	3L	Ss	47	11	43.5	14.5	.24	.153	1.5
	Total					87	18	78.75	26.25	.31	.113	2.7

matings, but one (19) and here there is an excess of silky feathered birds.[4]

The data given in Table II pertain to those matings in which three normally feathered birds are expected to one silky. The types of matings are similar to those described for Table I. The numbers obtained for mating 21 are closer to expectation than for matings 22 or 24. There is also a deficiency of recessives in this table.

The $\frac{\text{Dev.}}{\text{P.E.}}$ was determined for each mating and each group of matings. The formula used was that for Mendelian ratios of 1:1 and 3:1, namely P. E. $= .6745\sqrt{\frac{p \times q}{n}}$, where p and q are the elements of the expected ratio and n the total number of individuals obtained in any one mating or group of matings. The values are in some cases a little high but in no instance are they so large as to vitiate the interpretation of the results.

A further test of the genetic correspondence of the plumages of the sporadic and purebred Silkies was made in another mating (No. 17) of an extracted F_2 sporadic silky by a purebred Silky. Twenty silky feathered chicks were obtained and no normally feathered ones.

The foregoing data, therefore, appear to demonstrate conclusively that the silkiness exhibited by sporadic silky 1A is the same genetically as that of the purebred Silky Fowl.

DISCUSSION

It is evident from the foregoing discussion that silkiness has occurred sporadically in domesticated fowls for a long time, very likely ever since their domestication, and the character has from time to time been combined with various others to form different breeds of Silkies. The evidence, so far as it goes, would seem to indicate that it is the same factor concerned in all cases. It is not improbable that silky plumage cropped out occasionally also in the wild progenitors of the domestic fowl, and for that matter it may still do so in the wild Jungle Fowl, though no mention of it has been noted. The fact,

[4] The color of the F_1's of the sporadic silky-White Leghorn cross, as well as those from reciprocal crosses of the purebred Silkies with White Leghorns, was white with splashes of black pigment. The F_2's were of various colors including blue, black, white, red, and white combined with varying amounts of the other colors.

however, that a similar condition has been found in other wild species makes such an assumption seem likely.

It is impossible to state whether the different sporadic appearances are due to independent mutations or whether they all trace back to an original mutative change which has been carried down through the various ramifications of descent and into the many breeds of the present time. There appears to be no evidence of the character appearing in stock known to be homozygous for normal feathers, but on the other hand cases where such a condition could be asserted must be very rare. On the basis of what is known of the occurrence of mutative changes at present, it seems most probable that the large preponderance of cases of sporadic appearance of silky plumage are simply due to the chance mating of birds carrying the silky factor in heterozygous condition. The occasional recurrence of the mutation *de novo* is, however, not improbable, but even so, it could of course not become visible in effect until two individuals both carrying it should come together.

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An Introduction to Social Hygiene

Menschenzucht, von Dr. Franz Kisch. Pp. 100, kart., preis M. 7. A. Marcus and E. Webers' Verlag, Bonn, Germany, 1920.

In this brief book apparently intended for adolescents, Dr. Kisch has succeeded in giving a remarkably good and sensible outline of social hygiene. His chapter headings are "The Ripening of Love," "The Wonder of Creation," "Heredity and Selection," "Fertility," "Children Outside of Marriage," and "Marriage." A book in English covering similar ground and written in a similar unsentimental and matter-of-fact tone would be well worth while.—P. P.

REVERSION IN COMPOSITES

The Sudden Appearance of Far-distant Ancestral Types of Inflorescence

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FOR several years the writer has studied the morphological variations in *Crepis capillaris*, a cosmopolitan plant belonging to the chicory group of the Sunflower family. During this time seeds have been secured from many localities of Europe, Asia, Africa and the American continents. In seeds from such diverse sources one would expect to find considerable morphological variation and such has proven to be the case.

In an F_1 population secured by crossing a plant of a Holland strain, which had grown in our garden at Berkeley for three years, with a plant of a Sweden strain which had grown in our garden for two years, there appeared a single plant having foliaceous palea-like bracts subtending the achenes on the receptacle of every capitulum. The normal condition in these plants shows a perfectly smooth and naked receptacle. The appearance of these palea-like organs is considered as a possible reversion to a pre-composite type of inflorescence because the phylogeny of the composite form of flower aggregation indicates that the progenitors of the family possessed such structures as a part of their inflorescence. There are at least two possible lines of development of the composite capitulum; one coming from a spike-like inflorescence and the other from an umbel or a racemose umbellate type. In a typical spike the individual flowers or spikelets are usually well spaced apart, rather large and each subtended by a bract, a condition similar to that which we now find in the grasses, cereals, etc. Reduction in the length of the central stalk of the inflorescence proper (in a spike termed the rachis) would cause the inflorescence to become more compact and at the same time cause loss of some of the subtending bracts as a result of the crowding; the end result would be an approach to the composite capitulum.

However, according to the opinion of James Small,[1] the receptacle from such a source, would rarely if ever become entirely flat but would tend to assume a rounded, conical shape such as the fleshy receptacle of the strawberry or the compact inflorescence of Dipsacus, the common teasel.

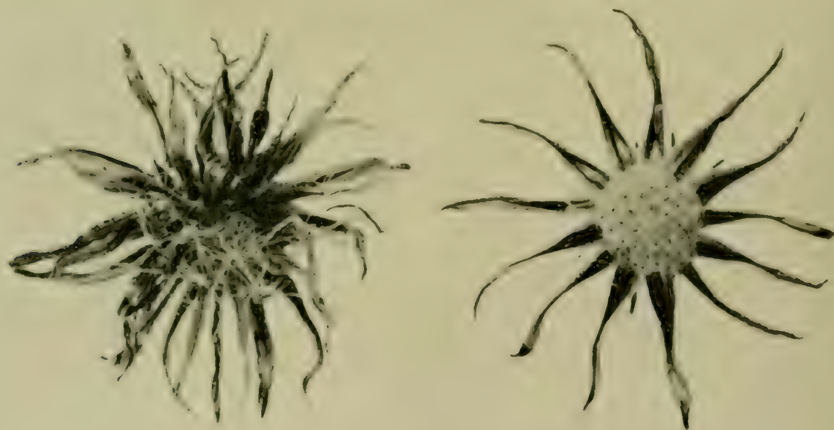
On the other hand, the flowers in an umbel are already crowded and thus reduced in size, the outer florets receiving more illumination and space causing them to become zygomorphic, a condition found in almost all composites exclusive of the Cichoraceae. The pedicels at their insertion on the peduncle are more crowded than the florets at the top of the umbel so that the bracts subtending the pedicels of all the flowers except the outer whorl have already become much reduced or have disappeared. Now if complete abortion of the pedicels occurred the florets would then become seated directly upon a more or less flat receptacle with much reduced inner bracts or none at all. The parts of the calyx of the outer whorl of florets would then form the involucre while a shortening of the peduncle, or stalk, below the inflorescence would cause a transformation of cauline leaves into the calyculus, subtending and partly enclosing the involucre, which is a more or less general character throughout this family of plants.

A study of proliferation of the inflorescence such as one may occasionally find in some genera of the family (Crepis and Hypochaeris) supports the umbellate origin hypothesis (Fig. 18). In these cases, instead of the sessile florets being produced on the receptacle, pedicels are formed, each of which will

[1] Small, James. Origin and Development of the Compositae. London. 1919.

A REVERSION TO AN ANCESTRAL CONDITION

Here are the capitula, or heads, of two different types of *Crepis capillaris*, a wild plant of the sunflower family. The ripe achenes (small, dry, one-seeded fruits) have been removed. The normal condition of this plant is shown in the smooth flat-topped receptacle at the right. The head at the left shows a reversion to some distant pre-composite ancestral plant in which each seed had a bract at its base. Normal plants possess bracts only around the head. (Fig. 16.)



TOP VIEW OF THE SAME HEADS SHOWN ABOVE

Composites embrace the most highly developed families in the vegetable kingdom. They are characterized by having many small flowers or florets borne in compact heads resembling single flowers—such as the daisy, dandelion, aster, and sunflower. The composites form about one-tenth of the living seed plants and are distributed in all parts of the world. They are considered the highest plants on account of the remarkable extent to which they display union of parts. (Fig. 17.)

AN ANCESTRAL TYPE OF FLOWER CLUSTER

This is a compound inflorescence formed from the head of *Hypochearis radicata* (commonly called Cat's-Ear) growing wild. It may be considered as the reappearance of an ancestral type of inflorescence which characterized the family at some remote period. The flower head at the end of the stem should normally have been very similar to our common dandelion. Some simple umbels, or flower clusters, and unopened flower buds are shown at the bottom. Photograph natural size. (Fig. 18.)

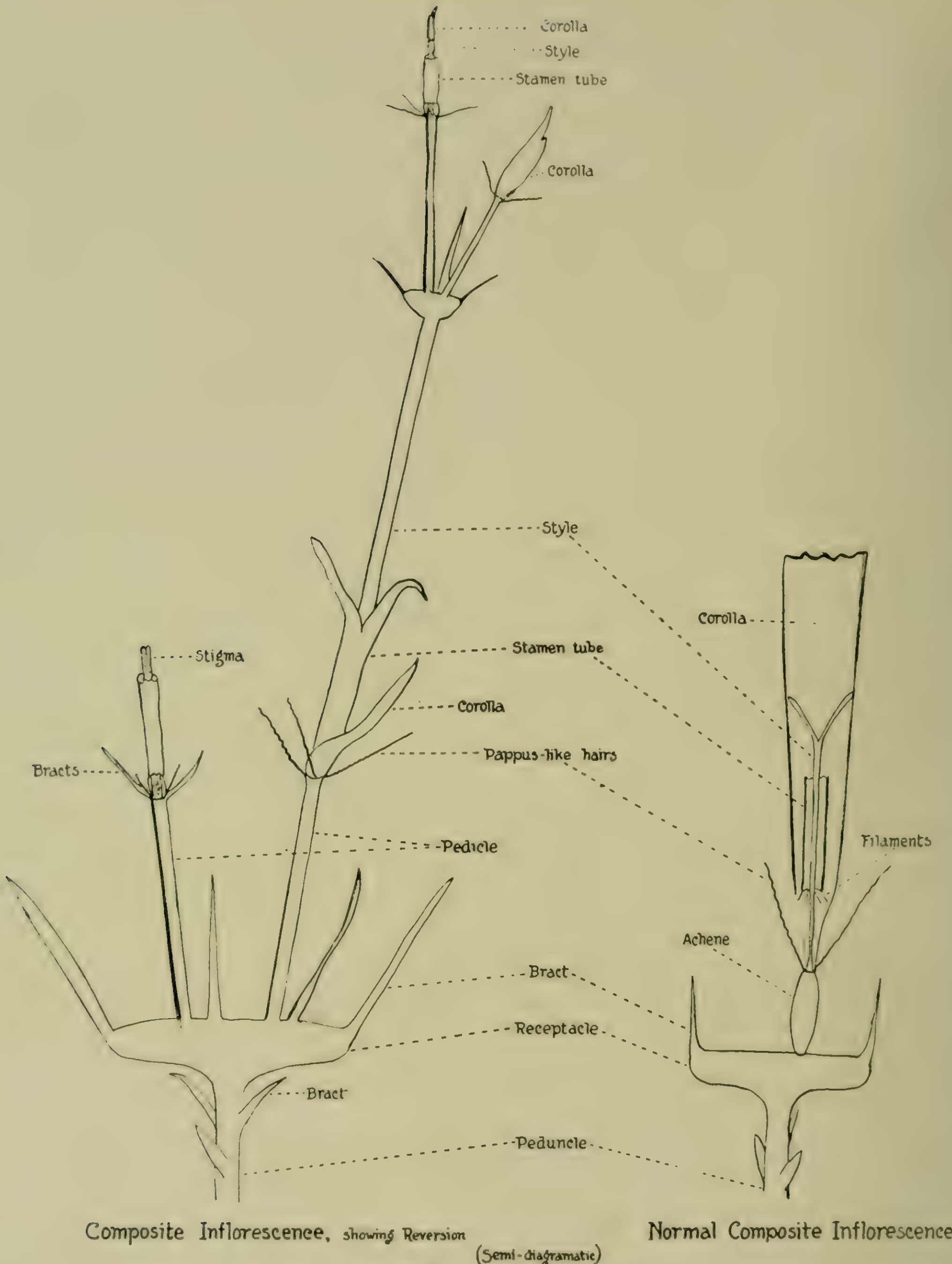


DIAGRAM OF COMPOUND INFLORESCENCE

The flower cluster shown in Fig. 18 on the preceding page is here outlined by diagram giving the details of structure and position as compared with the structure and position of the same organs in a normal composite inflorescence of this genus. No achenes appeared on the head which showed the reversion. (Fig. 19.)

bear a single imperfectly developed floret or may have in the place of a floret a smaller capitulum which has proliferated in exactly the same way on a smaller scale. In the latter case each smaller pedicel bears an imperfectly developed floret. The capitulum has in such a case produced a compound umbellate inflorescence. On the receptacle each pedicel which replaces an achene appears to be subtended by a palea or bract.

The appearance of palea-like bracts on the receptacle subtending achenes (Fig. 16) may be considered as a parallel change to a still further remote ancestral condition if we assume that in the precomposite, umbellate progenitor the palea-like bracts on the receptacle, excepting those of the outer florets, had disappeared already. (Fig. 16.)

The appearance of such reversions cannot be predicted but it is possible to offer a very logical explanation for their appearance. Such characters in the ancestral form may have been the somatic expression of a number of interacting genetic factors. During evolution of the family, these factors became separated into different individuals and perhaps even into different species so that they no longer were able to produce their typical combined somatic effect. The factors still exist, but in a separated and inactive condition at least insofar as the palea are concerned. As a result of cross fertilization and the operation of the law of chance there are brought together in a few cases all the necessary factors within a single plant and the character is again produced as a result of their recombination.

The cross of two white Emily Henderson sweet peas, which in the F_1 hybrid produced a purple sweet pea like the native sweet peas of Sicily, is well known as a typical case of reversion to an ancestral character. In this case two factors operating together in the same plant produced the purple color typical of the peas of Sicily, but either factor by itself could produce only plants with white flowers. Each parent had contributed to the hybrid plant what the other parent lacked.

The most convincing evidence for this factor explanation of the sudden appearance of reversionary types is furnished from the work with *Drosophila melanogaster*. It is possible to take two mutant types[2] which have bred true to the mutant character for many generations, each differing markedly in at least one character from the wild type, and in the first generation from a cross between them produce the wild type of fly.

Another possibility which may be considered is that a mutation occurs which restores to a single plant a genetic factor which had been eradicated from the hereditary material by a loss mutation during the evolution of the species. The final conclusions must, in any case, be drawn from the results of breeding tests and experiments.

[2] Types of flies which are different from the normal wild flies from which they originated and which have appeared as a result of a sudden change in the constitution of the hereditary germinal material.

The Farmer's Botany

TEXT-BOOK OF PASTORAL AND AGRICULTURAL BOTANY, for the study of the injurious and useful plants of country and farm. By John W. Harshberger, Ph.D., professor of botany, University of Pennsylvania. With 121 illus. Pp. 294. Philadelphia, P. Blakiston's son and Co., 1920.

Dr. Harshberger has compressed within small compass much useful information and references on poisonous plants, and also on the principal economic plants. The material was originally presented by him to classes of veterinary students. It will be valued, however, by anyone with some scientific education, who is interested in agriculture.—P. P.

PROGRESS IN HORSE BREEDING

Improvement in Breeds Evidenced by the Best Horses Constantly Attaining Faster Speed Records

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At least two breeds of horses are making progress if the accurate records of their deeds are correctly interpreted. Both the Standardbred and the Thorobred horse are making new records almost every year. Since records have been kept neither breed has failed to make improvement during a generation. The improvement has been so rapid that usually many new records are made in the life time of any one horse. The racing period of a horse, however, does not extend over five or six years. Most trotting and running horses race during the two and three-year-old form only.

SPEED RECORDS OF THREE-YEAR-OLDS

Perhaps, the progress made by trotting horses can best be shown by giving the records made by the three-year-olds of the breed. (*Continued below.*)

1860	Elvira Whiteside made the world's record for three-year-olds:	2:39
1874	Lady Stout " " " " " " " "	2:29
1883	Hinda Rose " " " " " " " "	2:19½
1889	Axtell " " " " " " " "	2:14
1892	Arion " " " " " " " "	2:10½
1910	Colorado E. " " " " " " " "	2.04¾
1914	Peter Volo " " " " " " " "	2:03½
1917	The Real Lady " " " " " " " "	2:03
1920	Sister Bertha " " " " " " " "	2:02¾

It will be noted that in 60 years the record for three-year-olds has been reduced from 2:40 to 2:02¾. When Peter Volo made the unexpected race record of 2:03½ in 1914 the prediction was made that the limit of speed for his age has been reached; but Miss Bertha Dillon equaled his record in 1917, while the Real Lady cut one-half second off the time. Three years later Sister Bertha, a full sister to Miss Bertha Dillon, placed the time at 2:02¾. The ambition of the breeders is to make the three-year-old record 2:00, and there are reasons for believing they will do it.

SOME SPEED PRODUCING FAMILIES

It is interesting to study the families from which speed improvement is coming. There have been registered in the American Trotting Register Association many thousands of stallions who have had opportunity in the stud. The vast majority add nothing to the evolution of the breed.

There were more than 1,000 three-year-old horses in 1918 which might have been eligible to the races of that year. Of the number which did race, nineteen secured records of 2:10 or better. Six of them were sired by Peter the Great while five were by Axworthy's sons: Dillon Axworthy siring three, Guy Axworthy one and Gen. Watts one. This does not tell all the story of the influence of Peter the Great and Axworthy as five of the dams of the 1918 2:10 three-year-olds are by the two dominating sires of the breed.

During the season of 1920 there were 21 three-year-olds that made records of 2:10 or better. Eleven of these were by Peter the Great and his sons, three by the sons of Axworthy and three by The Harvester.

THE GREATEST SIRE OF ALL BREEDS

For a decade the get of Peter the Great have won a very large proportion of the two and three-year-old races and futurities. No sire of the breed has come near to him in influence. Having a racing record himself of only 2:07¼

THE MOST VALUABLE DOMESTIC ANIMAL EVER PRODUCED

Man O'War has won a larger sum of money than any other horse in American racing. At three years of age "he not only won all his races but in doing so reduced the world's records for certain distances for horses of all ages." He comes from a notable line of ancestors which have given him his fine muscular development and remarkable combination of speed factors. Note the refined head; short, alert ear; attractive eye, prominent chest, long legs, clean flinty bone, and heavy muscles. (Fig. 20.)

as a four-year-old he has been regularly siring colts that exceed his record when two and three years old, and some of his aged sons and daughters have dominated the races of the Grand Circuit. It is, no doubt, correct to refer to him not only as the most successful sire of his breed but also as the greatest sire of all breeds.

Something of his power to improve the breed may be seen by the following comparison. There are twelve sires of the breed who have produced five trotters whose records are 2:10 or better. There are eleven sires who have produced six. There are fourteen who have produced from seven to nine. There are seventeen who have sired from 10 to 27 each in the 2:10 list; while Peter the Great has sired fifty-nine who have records from 2:10 down to 2:01¾ and he has one pacing daughter that holds the world's record as the fastest pacing mare, Miss Harris M 1:58¼.

The question naturally arises why should one sire have such marked ability for breed improvement? Evidently there is concentrated in him the com-

bination of factors necessary for speed and this concentration has not been possessed by any other horse. It may be said that neither his pedigree nor his record as a race horse gave promise of his wonderful influence as a sire.

THE THOROBRED

No breed of domestic animals has been bred as long and as successfully as the running race horse. The one method pursued in increasing speed in the race horse has been to mate extreme speed with extreme speed. For many generations the infallible custom has been to eliminate the stallion that did not show high class racing ability. Fortunately there is such a large crop of foals each year that only a very few of the males need be kept for stud duty. The race track is used as the instrument of elimination. The colt that cannot go out and win has no chance to be transferred to the stud. To be used as a sire he must show speed, intelligence and gameness. No matter how fine his pedigree may be or how perfect his conformation he is ruthlessly cast aside unless he can get his nose under the wire first.

Not quite so severe a test is required of a mare, but she too must be intelligent, game and show speed if she is given the best opportunities for reproduction.

The result of the rigid elimination is a pure germ plasm. It is no exaggeration to say that the Thorobred is homozygous, or pure, for speed. Breeders can accurately forecast the minimum speed to be expected from any mating, provided the foal comes to racing age in a sound condition. No breeder attempts to say which foal will be an improvement over his ancestors but he does not hesitate to predict a substantial record which he believes will be excelled. As all Hereford cattle are white in the face, so all Thorobred horses are fast at the running gait. The breed is certainly purebred for the characters of speed.

Something of the progress being made by the American Thorobred can be seen from the following tabulation of the horses of the breed who have made the American records for one mile.

Year	*Horse*	*Time*
1872	Alarm	1:42¾
1875	Searcher	1:41¾
1877	Ten Broeck (Against Time)	1:39¾
1890	Racine	1:39½
1900	Voter / Orimar	1:38
1901	Brigadier	1:37⅘
1903	Dick Wellse	1:37⅖
1908	Center Shot	1:37⅕
1914	Amalfi	1:36¼
1918	Sun Brier	1:36⅕
1918	Roamer (Against Time)	1:34⅘
1920	Man O'War (3-yr-old)	1:35⅘ Race Record
1890	Salvator (Straight course)	1:35½

It has taken 48 years to reduce the record $6\frac{19}{20}$ seconds, or from 1872 to 1920.

MAN O' WAR

In the crop of yearlings from the Nursery Stud, Lexington, Ky., sent to the Saratoga sale in 1918, was a chestnut colt by Fair Play—dam Mahubah by Rock Sand. The owner, Major Belmont, sold all his yearlings that year because of his activities in the great war. The chestnut colt, Man O' War, was described at that time as a good sized and well balanced yearling; and brought the high price of $5,000.00, being bought by S. D. Riddle.

The sire of Man O' War, Fair Play, was the best three-year-old of his season. The grand-sire, Hastings, was a brilliant race horse and noted as a sire. The great grand-sire, Spend Thrift, was unbeaten as a two-year-old. The g.g.grand sire Australian was imported from England and has left an indelible impression on the American Thorobred.

The dam of Man O' War, Mahubah, is by Rock Sand one of the very great sires of the breed. She herself won but one race as a three-year-old and was retired to the stud.

No other horse in American racing has ever won such a large sum $249,465, as Man O'War. No two-year-old could

make him extend himself to win. He was even a more outstanding race horse at three than he was at two, for he not only won all his races but in doing so reduced the world's records for certain distances for horses of all ages. He must be hailed as the racing king.

He is a chestnut horse, close to 16 hands in height. His legs are long, and his barrel has more length than many of his breed. The single feature of his physical form most striking is the net-work of prominent muscles. One could not imagine a better muscular development than he possesses. His neck rises gracefully from his withers and the head is small, refined and very attractive. To date he is the perfection of the breeders' art, and the most valuable domestic animal ever produced.

He holds five world's records gained in five races at various distances:

May 29,	1920	Belmont Park	1 mile—time	1:35⅘	World's Record
July 10,	1920	Aqueduct	1⅛ " "	1:49$^{1}/_{5}$	" "
June 12,	1920	Belmont Park	1⅜ " "	2:14$^{1}/_{5}$	" "
September 11,	1920	" "	1½ " "	2:28⅘	" "
September 4,	1920	" "	1⅝ " "	2:40⅘	" "

Feminism and Sex Extinction, by Arabella Kenealy, L.R.C.P. Pp. 313, price $5 net. New York, E. P. Dutton and Co., n.d.

The "feminist" movement might more appropriately be called the anti-feminist movement, since it seeks to do away largely with the special distinctions which mark woman out, socially, industrially, and politically, as a female. Miss Kenealy says the logical end of this movement is the elimination of all possible differences between the sexes, in order that women may be able to compete with men in every department of life on equal terms; and she holds that great injuries will result, to the race, if this movement is carried on. Her thesis is that wide differentiation of the two sexes in "body, brain, and bent" is the best way to produce a better race.

A fascinating and valuable book might be written on this thesis, but Miss Kenealy has not the equipment to do it. The many facts and sound conclusions in her work are so elbowed by pseudo-science, mysticism, rhapsody, and error, that they get much the worst of it. To quote a sample of her biology:

"Weismann describes the Germ-Plasm as being transmitted in the female line solely, from ovum of mother to that of daughter. This supports the above view; namely, that the Germ-Plasm proper is inherent in the ovum, in which it exists in potential, or undifferentiated, form, and that it becomes differentiated (in both sexes) into a right and left-reproductive gland of contrary sex-inherence, by differentiative power of the dual-sexed sperm-cell."

It is a pity that so good a cause should have been so poorly presented.—P. P.

Keeping Children in School

Every State now has a compulsory day school attendance law, according to the Children's Bureau of the U. S. Department of Labor.

In five States attendance is required until 18 years of age, in two of these in certain districts only; in 3 until 17; and in 32 until 16. One State requires attendance until 15, six others and the District of Columbia until 14, and one State requires attendance until the age of 12 years, but applies this to illiterates only.

HERITABLE CHARACTERS OF MAIZE

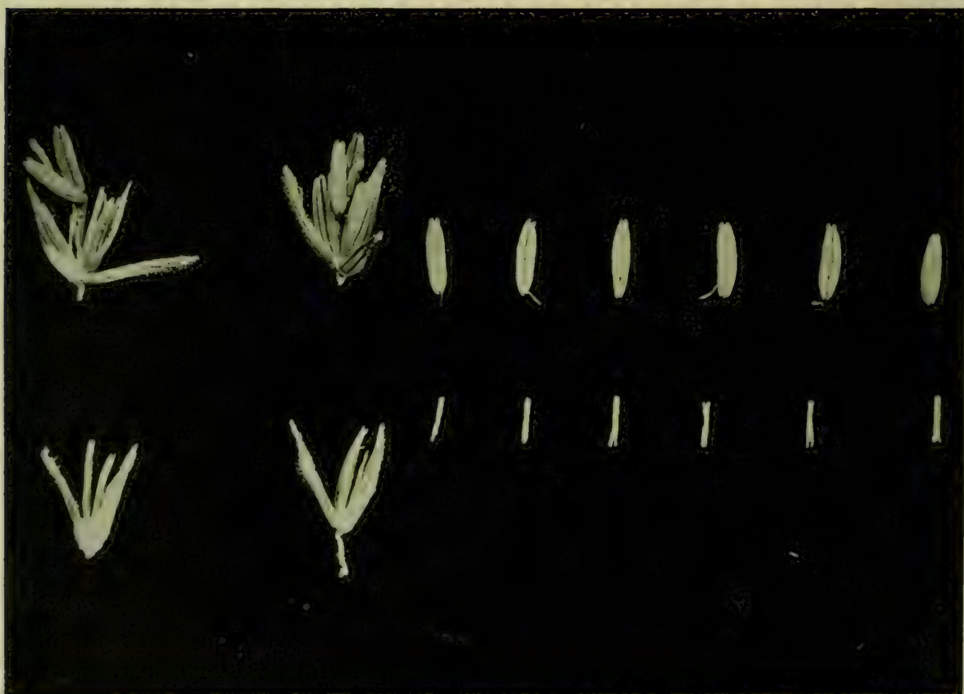
VII. MALE STERILE[1]

Lewis A. Eyster
College of Agriculture, Cornell University, Ithaca, New York

IN SOME earlier experiments with maize Dr. R. A. Emerson observed that some of his plants failed to produce pollen. Later, it was recognized that these plants were occurring in proportions approximating 25 percent in progenies from two closely related self-pollinated ears. Crosses and backcrosses have shown this male sterility, designated by the factor symbol *ms*, to behave as a simple Mendelian recessive to normal. Tables I and II give the numbers obtained in a few cultures.

DESCRIPTION OF STERILE PLANTS

Male sterile plants are distinguishable from the normals only in the tassel and anthers. No pollen forms in the anther sacs and they remain undeveloped. Figure 21 shows the relative sizes of anthers of normal and of male sterile plants. The sterile spikelets are almost empty and usually remain flattened against the rachis, giving a characteristic appearance to the whole tassel. This appearance is shown by the male sterile tassel in Figure 22 as contrasted with the normal tassel in



HOW STERILE MAIZE ANTHERS COMPARE WITH NORMAL ONES

The photograph shows some spikelets and individual anthers from normal maize tassels at the top in comparison with the spikelets and anthers from male sterile tassels below. The latter are almost empty; no pollen forms in the anther sacs and they remain undeveloped. (Fig. 21.)

[1]Paper No. 91, Department of Plant Breeding, Cornell University, Ithaca, New York.

A MALE STERILE TASSEL

Compare this sterile tassel with the normal one on the following page. The two are of the same age. "Male sterile plants are distinguishable from the normals only in the tassel and anthers." (Fig. 22.)

A NORMAL MAIZE TASSEL

It is not difficult to distinguish normal tassels from sterile ones at the time the former are shedding their pollen but "after the anthers of the normal plants have fallen off, it becomes difficult or impossible to distinguish between normal and male sterile plants. (Fig. 23.)

Figure 23. No intermediates are produced and the heterozygous forms appear normal. It is not difficult to classify plants at the time the normals are shedding pollen. Immature normal tassels bear some resemblance to the male steriles, but the spikelets are plump and firm even when quite young. After the anthers of the normal plants have fallen off, it becomes difficult or impossible to distinguish between normal and male sterile plants.

TABLE I. *Number of Normal and Male Sterile Plants in Progenies Grown from Self-Pollinated Heterozygous Plants, Ms ms*

Pedigree	Normal	Male Sterile
A133–12	48	17
S11–1	33	11
Total	81	28
Expected (3:1)	82	27

TABLE II. *Number of Normal and Male Sterile Plants in Backcrosses to Male Sterile, ms ms x Ms ms*

Pedigree	Normal	Male Sterile
Er276	50	53
Er277–280	104	110
Er283	92	91
Total	246	254
Expected (1:1)	250	250

SOME PROBLEMS OF POPULATION IN JAPAN

OCCIDENTAL nations have been overwhelmed with data regarding their population problems during recent years, but for the orient they have had little except generalities. The following remarks in the London *Times* of May 28, 1920, from J. O. P. Bland, who was for many years secretary to Sir Robert Hart in China, are therefore interesting. One need not, however, share his belief that the food-producing powers of the two hemispheres have reached their limit, and one is certainly not obliged to conclude with him that a high rate of infant mortality is necessarily due to a scarcity of food.

"The prevalent conception of Japan as an aggressive militarist nation owes much of its origin, no doubt, to the Government's policy towards China. But if those who criticise that policy would trace the unbroken connection between it and the country's imperative economic necessities, they would be compelled to make more allowance than they usually do for the absence of altruism and lofty idealism in Oriental statecraft. For a nation to claim the right to expansion in a spirit of wanton aggression is one thing; to do so under the compulsion of a fierce struggle for bare existence for food and elbow room, is merely to obey the first law of nature, as every active, self-helping race has obeyed it since the beginning of time. A native writer put the problem succinctly when he said: 'The Japanese people must either die a saintly death in righteous starvation or expand into the neighbour's back-yard and Japan is not that much of a saint.'

"The problem which Japan has to face is easily stated. It is merely a question of providing food for a population which already exceeds the limit which the country's soil can support, and which is debarred by our exclusion Acts from seeking relief in the least populated regions of the American and Australian continents. The problem is in reality only one of many manifestations of the unpleasant truth, which the war has brought home to the world at large, that the pressure of population upon this planet's food capacity has become, and must remain, acute. The severity of this pressure in Japan is grimly indicated by a death-rate which averages 21.5 per thousand, and by the fact that 260 out of every 1,000 deaths are those of children under twelve months old.

"The elemental facts of the Japanese situation are (1) that, with a birth-rate

of 32 per thousand, the population increases every year by about 750,000; (2) in the last ten years the inhabitants of Japan proper (excluding Korea and Formosa) have increased from 50 to 57 millions, which gives an average of 380 to the square mile; (3) that during this period the area of land under cultivation has been increased by 5 per cent, and the rice production by 4 per cent, as against an increase of 12 per cent in the number of mouths to be fed. So long as the present birth-rate is maintained, the nation must therefore depend more and more upon imported food supplies. Now, there is no possibility of materially increasing either the area under cultivation or the productivity of the soil. In Japan the rice fields not only fill the valleys, but everywhere on the hill sides you will find them, terraced and artificially irrigated at an incredible cost of human labour. As I journeyed this spring from Mogi to Kobe by the railway which skirts the beautiful shores of the Inland Sea, it seemed to me that the villages had grown perceptibly larger and the rice fields smaller during the last ten years. The dead occupy no space in the food-growing area here, as they do in China. As one sees the children swarming in these close-clustering hamlets, one cannot help wondering can these tiny fields be still further sub-divided, and, if not, what peaceful solution of the problem can there be other than wholesale emigration?

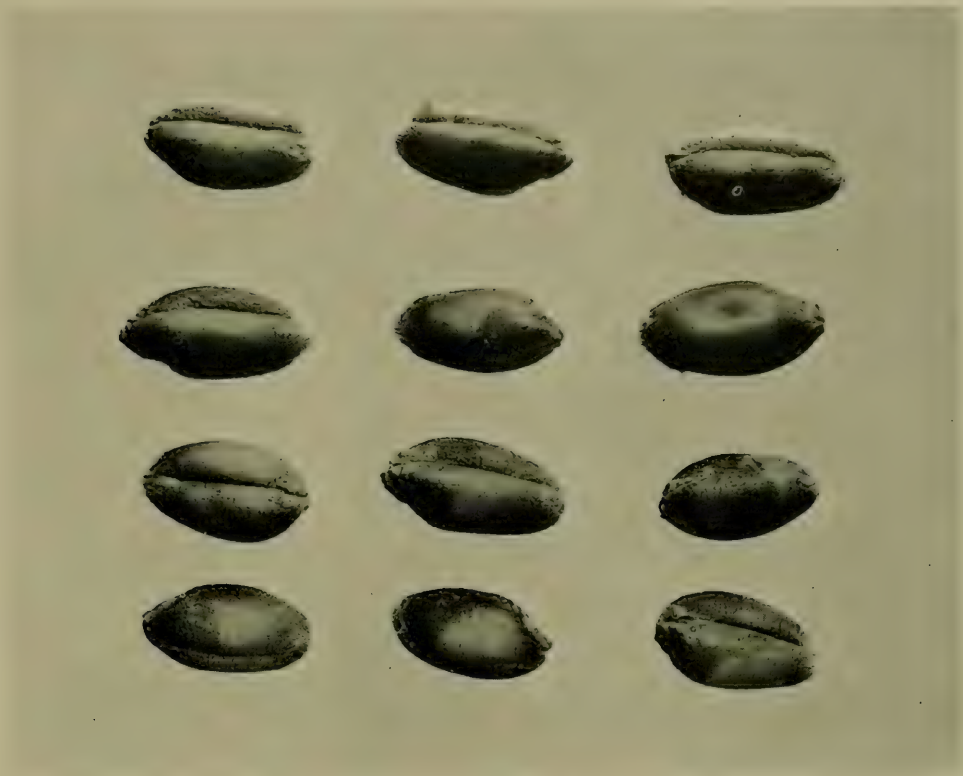
"So long as Japan can purchase the surplus food she needs by a favourable balance of trade, the problem may be faced. But Japanese statesmen take long views, and they realize that every year's addition to the population means a corresponding increase of imported food, which in turn necessitates an increased sale of Japanese manufactured goods in markets where keen competition is inevitable. Looking at the problem in this way, and debarred from expansion into America or Australia, they are faced with three alternative solutions: (1) A reduction of the birth rate; (2) increase of food supplies to be obtained by means of industrial expansion; and (3) territorial expansion into the less populated regions of the Asiatic continent. So long as either of the last two alternatives is available, no reduction is to be expected, because birth control must involve a radical change of the race, mind and social system. Japanese statesmanship is therefore compelled to adopt one or both of the other alternatives."

THE COLOR OF WHEAT KERNELS

Wheat kernels of the different varieties and types vary in color from light yellowish to dark reddish or brownish-red. The kernels of any one variety are usually fairly uniform in color when grown under similar conditions, but may vary within certain limits with varying conditions.

The color of wheat kernels is due to a combination of the colors of the outer layer or bran and the inner portion or endosperm. Color of the bran is due to the presence or absence in it of brownish-red or orange-yellow pigment and the color of the endosperm is due to its texture or density. The texture of the endosperm in turn is relative to the size of the air spaces or vacuoles between its component cells. When these are relatively large a white starchy kernel results, when relatively small, a hard, corneous or translucent kernel.

The pigmentation of the kernel and to some extent the texture of the endosperm are inherited characters. Both are somewhat influenced by environmental conditions, the latter apparently to much greater degree than the former. A starchy texture in part or all of the endosperm may be induced by proper conditions in almost any variety or



KERNELS OF KINNEY WHEAT

The Kinney variety is a late spring wheat, commonly grown in the Willamette Valley of Oregon. It is known also under the names Surprise and Noah Island. The kernels in the photograph contained a peculiar color variation (which unfortunately could not be reproduced in this illustration) in that part of each kernel was distinctly red—the normal color character of Kinney—and the remaining portion was yellowish white, the character commonly associated with white wheat. Photograph by F. H. Lathrop, sent by Geo. R. Hyslop, Professor of Farm Crops in the Oregon Agricultural College. (Fig. 24.)

kind of wheat, but pigmentation of the bran layer, even in its different intensities, as found in different varieties, remains relatively constant.

The appearance of wheat resulting from the combination of bran and endosperm colors furnishes a basis for its classification. So there are found in the market classes or sub-classes such descriptive terms as "hard red," "soft red," "hard white," "soft white," "dark hard," and "yellow hard."

So stable are the characters concerned that the great bulk of wheat marketed in this country can be assigned without difficulty, by those familiar with its characteristics, to the particular group to which it belongs.

The above illustration shows some kernels of wheat known as the Kinney variety. The history of this wheat is not known, but it has been grown in the Willamette Valley of Oregon for about thirty years.

The straw of the Kinney variety is very glaucous when green but white and strong when ripe. The spike is awnless, linear oblong and erect and the glumes are glabrous, white and broad. The kernels usually are red, small and soft. The color variation mentioned here has been found on kernels from two different lots of wheat sold at Corvallis, Oregon.

ANNUAL MEETING OF THE ASSOCIATION

The eighth annual meeting of the American Genetic Association was held at the Association headquarters in Washington, D. C., on Thursday, January 13, 1921.

The Secretary, in a detailed report, reviewed the affairs of the past year, presenting the difficulties through which the Association had passed and how the JOURNAL had been forced to delay publication on account of the constantly increasing printing costs and other post war readjustments. However, a membership of 3420[1] was announced, the largest number in the history of the Association.

The report of the Treasurer showed that the income from membership dues still failed to cover the cost of publishing the JOURNAL. The resumption of publication was made possible through a loan of $2107.50 from an interested member. A change in the dues from $2 to $3 had been put into effect during the year, but even at the latter rate, as stated in the editor's report, the cost of the JOURNAL for each individual member was $3.21. It is hoped that the members will co-operate to increase the size of the Association, making the amount to be received from dues at least equal to the costs of publication and administration, and thus place the JOURNAL on a self-supporting basis. Less than a thousand new members will accomplish this goal, it is expected.

There have been two changes in the Council since the last annual meeting. Dr. W. C. Rucker, who has served as a member of the Council since its organization, resigned on account of his leaving the United States for service in Panama, and Dr. Sewall Wright of the Bureau of Animal Industry, U. S. Department of Agriculture, was elected to fill the vacancy. Dr. Alexander Graham Bell, who also was a charter member of the Council, resigned to accept the position of Honorary Vice-President of the Association, and James H. Kempton of the Bureau of Plant Industry, U. S. Department of Agriculture, was elected to fill this vacancy. With Dr. Bell, Mrs. E. H. Harriman was also elected an Honorary Vice-President.

The Association has been made the custodian of the Frank N. Meyer Memorial Medal Fund, created from a small sum bequeathed by the late Frank N. Meyer to the members of the staff of the Office of Foreign Seed and Plant Introduction to be used for whatever purpose they saw fit. They decided to use the fund for the awarding of medals for distinctive service in the field of plant introduction, and directed the Association through its Council to be the agency through which the medals should be awarded. The account of the first award to Mr. Barbour Lathrop was published in the April 1920 number of the JOURNAL OF HEREDITY. The second medal has been awarded to Dr. L. Trabut of Algiers, Africa.

Many other questions relating to possible activities of the Association were discussed, but it was decided that in view of the needs of the JOURNAL, other activities should be made secondary. Correspondence is increasing from all sources, and this indicates a new interest in the work of the Association and its JOURNAL.

The desirability of holding other than the regular meetings of the Association throughout the year was considered since suggestions of this nature have come from several members.

One of the important suggestions brought before the Association was that of a campaign to obtain the enactment of laws protecting originators of new varieties of plants and breeds of animals in much the same manner as inventors of mechanical devices now receive protection through patents.

The subject of immigration was introduced and the lack of adequate genetic and eugenic data to form the basis for control measures was deplored. It is hoped that these phases of immigration will receive thorough discussion before the enactment of permanent regulatory measures.

[1] This number has since increased to approximately 3700 members.

The

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CONTENTS

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THE AKALA, A GIANT RASPBERRY FROM THE HIGHEST MOUNTAIN OF THE PACIFIC

This remarkable raspberry, which sometimes attains two inches in diameter, was discovered many years ago by the U. S. Exploring Expedition, but living material and photographs of its largest forms have just been secured for the plant breeders of the world. There are two wild varieties already differing in color, flavor, and degrees of spininess. (Frontispiece.)

THE AKALA BERRY OF HAWAII

Asa Gray's Rubus Macraei, an Endemic Hawaiian Raspberry

J. F. Rock

Agricultural Explorer, Office of Foreign Seed and Plant Introduction
Bureau of Plant Industry, U. S. Department of Agriculture

THE native Akala of Hawaii (*Rubus Macraei*, Gray) was first discovered by the U. S. Exploring Expedition on the slopes of Mauna Kea, the highest mountain of the Pacific, at an elevation of 6,000 feet. The species was described by Asa Gray in the Botany of that Expedition and was figured in plate 57 accompanying the atlas.

No mention is made regarding its horticultural possibilities until the time of Hillebrand, who in his Flora of Hawaii on page 116 says, in a footnote: "The species can be recommended for cultivation." It may be stated at the outset that *Rubus Macraei* is a most variable species and after a close examination of herbarium material and field work it will have to be divided into several varieties if not actual species.

The Akala berry occurs on several islands of the group, as for example Kauai, Molokai, Maui and Hawaii. On Kauai it is an upright spineless shrub only a few feet in height, with rather small, dry berries. This type was placed by Hillebrand under *Rubus Hawaiiensis*, with which it has little relationship, being of an entirely different habit. It seems that Hillebrand confused both species considerably; and the Hawaiian species of Rubus represent another case of confusion such as has been found to exist in the species of *Pritchardia*, a genus of palms. On Maui the plants resemble, somewhat, the typical species from Hawaii, the type locality, but the plants are exceedingly spiny and the fruits not half the size of those found on Hawaii. It is from the Maui species, especially those coming from the much frequented slopes of Haleakala, that seeds were usually collected and sent to experimenters. *Rubus Macraei* finds its best development on the slopes of the high mountains of Hawaii proper—on Hualalai, Mauna Loa and Mauna Kea. The largest fruited specimens ever discovered by me were in a little oasis, a small volcanic cone of greater age than the country surrounding it. This cone, known as Hinakapanula, is located at 6,000 feet elevation in an absolute desert lava field resembling very much the famous "sand see" of Mr. Brown's Java. There was no vegetation to be found in this cinder plain, but the cone was one mass of jungle—it having escaped the destructive lava flows. The plants were mainly *Acacia koa hawaiiansis*, *Coprosma pubens*, *Styphelia tameiameiae* and *Rubus macraei*. Here *Rubus macraei* was not an upright shrub or bush but in reality a huge liana some 20 feet in length with a woody stem two inches in diameter. The berries were of a dark rich purple and at least two inches in diameter. A remarkable feature of the plants was the total absence of spines.

In the fern forests near the volcano of Kilauea there occurs another form of *Rubus macraei* which is also spineless, at least in older plants. This region has been given over to cattle grazing and consequently *Rubus macraei* has disappeared as a terrestrial plant and has only escaped total destruction there by becoming epiphytic. All the plants found there grow in the forks of moss-covered trees, or fallen monarchs of *Acacia koa hawaiiensis*. This would indicate that if it does require an acid soil it is at least not averse to such conditions. To be sure the berries are not as large as those found on Hualalai or Mauna Kea Islands, but still are over an inch and a half in diameter, and

THE AKALA BERRY BUSHES ON THE SLOPES OF MAUNA KEA

This giant raspberry covers many acres of ground at an altitude of 6,000 feet in a forest of Koa trees where it crowds out everything else. The climate is cool at this altitude; frosts are not uncommon, and the bushes are enshrouded with fog for the greater part of the day. This giant raspberry from Mauna Kea, Hawaii, together with the Giant Blackberry from Fusagusaga, Colombia (described in the JOURNAL, Vol. XI, No. 5) are good examples of the wild plants which are waiting to be used by the plant breeders in the making of superior varieties of cultivated fruits for our gardens. Even though we cannot match the cool, moist climates of the regions in which these two remarkable species occur, we should certainly be able to grow and flower them and use the pollen in the building of new races of blackberries and raspberries. (Fig. 1.)

A CLUSTER OF AKALA BERRIES ACTUAL SIZE

For comparison, a silver half-dollar is inserted. These were not the largest fruits collected; exceptional fruits measured two inches across and were as large as a silver dollar. They are juicy, with small seeds, and vary in flavor, some having a slightly bitter taste, while others are very delicious. There is a dark purple and an orange yellow variety, the former borne by almost spineless plants, the other on spiney bushes. Authentic specimens of both these varieties are now in the collection of the Office of Foreign Seed and Plant Introduction of the Department of Agriculture in Washington. (Fig. 2.)

this with a minimum of humus and an absence of real soil.

On my return from the Orient I decided to stop over in Hawaii for the purpose of securing seeds and root shoots of this remarkable species for the plant breeders to experiment with.

I went to the type locality on the slopes of Mauna Kea, in company with Mr. Kraebel, Assistant Superintendent of Forestry, together with my friend and traveling companion, Mr. S. Jurgens. We found *Rubus macraei* covering many acres of ground in a forest of Koa trees, forming the undergrowth to the exclusion of everything else. Here at 6,000 feet elevation on the windward slopes of Mauna Kea the atmosphere is always cool and the nights even cold, frost being not uncommon in the winter. After eleven o'clock clouds invaribly ascend from the sea and the slopes of the mountain at this elevation is invariably enshrouded in fog for the greater part of the day.

Rubus macraei grows here as a terrestrial upright, but does not become a liana as is the case in Hualalai. It is a most prolific bearer and the buds of the whip-like branches bend under the weight of the luscious, heavy fruits. We found here two distinct varieties—one dark purple and one a bright orange-yellow. One of these yellow fruits exceeded in size even the largest of the purple fruited variety; it was in fact larger than a silver dollar, being two inches in diameter. This yellow variety was, however, quite spiny, while the purple one was almost spineless, only the young shoots being armed.

The juiciness of these fruits is remarkable—a fact which might prove a disadvantage as it will probably make the berry a poor shipper. The seeds are quite small and all the rest is juice. The dark variety is slightly bitter, while the yellow variety is quite sweet and really delicious. Hybridization may work wonders with this species and its distinct varieties. It would be best adapted, in the United States, to a locality with mild winters and fogs; I suppose on the Pacific slope wherever the redwood occurs would fill the requirement.

I am indebted to my friend, Mr. A. McAllester of Kukaian Ranch, Mauna Kea, through whose kind hospitality and courtesy, the furnishing of horses, etc., I was enabled to secure valuable living material which is being propagated for distribution to experimenters.

RACE AND NATIVITY OF FARMERS IN THE UNITED STATES

According to a report of the Fourteenth (1920) Census recently issued, of the 6,448,366 farmers in the United States in 1920, 5,498,359 were white and 950,007 were colored, while in 1910, out of a total of 6,361,502 farmers, 5,440,619 were white and 920,883 were colored. White farmers thus represented 85.3 per cent of all farmers in 1920, as compared with 85.5 per cent, or practically the same proportion, in 1910.

Between 1910 and 1920 the number of white farmers increased 57,740, or 1.1 per cent, and the number of colored farmers, 29,124, or 3.2 per cent.

The 950,007 colored farmers in 1920 comprised 926,257 Negroes, 16,213 Indians, 6,899 Japanese, and 638 Chinese. The corresponding figures for 1910 were 893,370 Negroes, 24,251 Indians, 2,502 Japanese, and 760 Chinese. The following table gives the figures in convenient form.

(The number of farmers is assumed to be the same as the number of farms.)

	Number	Per cent of total
All farmers:		
1920	6,448,366	100.0
1910	6,361,502	100.0
White farmers, total:		
1920	5,498,359	85.3
1910	5,440,619	85.5
Native white farmers:		
1920	4,917,305	76.3
1910	4,771,063	75.0
Foreign-born white farmers:		
1920	581,054	9.0
1910	669,556	10.5
Colored farmers:		
1920	950,007	14.7
1910	920,883	14.5

A NEW TANGELO

The Origin of a Fink-Fleshed Citrus Fruit by Hybridization

WALTER T. SWINGLE AND T. RALPH ROBINSON
Bureau of Plant Industry, U. S. Department of Agriculture

AMONG the fruit crosses made at Eustis, Florida, in 1908 was one in which pollen of the Sampson Tangelo[1] was used to pollinate flowers of a seedling grapefruit of good quality. This cross was made by Mr. F. W. Savage, plant breeder, acting under the direction of the senior author.

From the grapefruit resulting from this cross, sixty seeds were obtained. Two of the resulting seedlings have fruited out at Eustis showing hybrid character with no points of especial promise. To distinguish this hybrid from the first cross of tangerine and grapefruit, the combination is designated a "tangelolo" (from "tangelo" and pomelo), but popularly this fruit should be classed with the tangelos. The freeze of 1917 destroyed most of the original seedlings and buds of this hybrid at Eustis, but one bud (Crop Physiology and Breeding No. 47,220) which was inserted in March 1914 on an old sour orange tree, and which survived, bore fruit during the season of 1918. The first fruits were picked November 6 and sent in to Washingotn for examination. About four dozen fruits were borne on one branch the first season, four years from time of budding.

In general appearance, size, shape and character of rind, the fruits resemble the pollen parent (the Sampson tangelo) but on cutting the fruit, it appears to be a rather remarkable hybrid. The color of the pulp, or rather of the lining membrane and partition walls, is a reddish pink (Ridgeway, Peach Red, Plate I b 5,00–R, in some fruits Corinthian Red). This color often shows in small blotches through the rind itself.

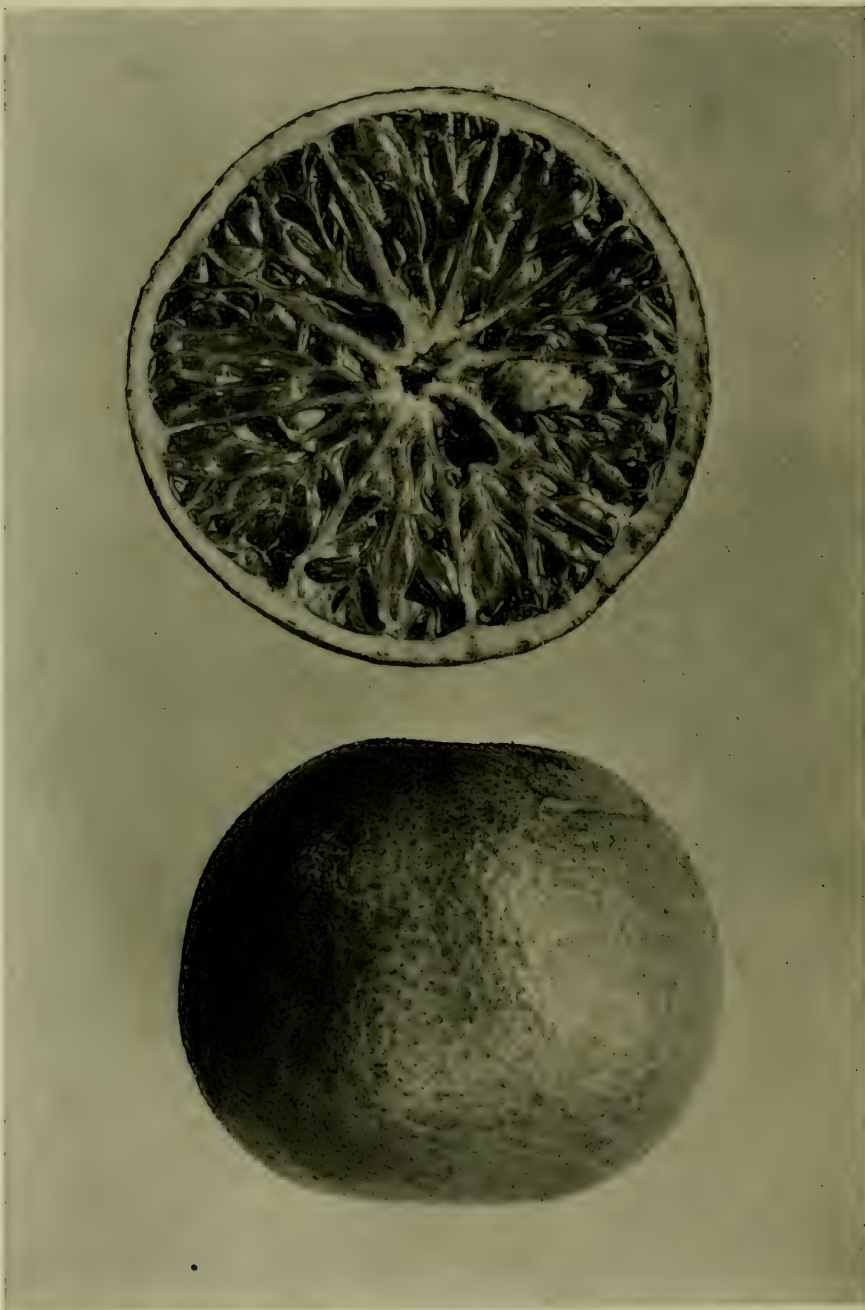
The pulp vesicles, when removed from the fruit, are seen not to be colored, though on cutting the fruit this is not at first realized. The pulp is of grapefruit character, with large vesicles and of pale orange yellow color (Ridgeways, Plate 111, f 17.0–Y.), and it is very juicy. Moreover, this fruit was sweet and apparently mature when first cut on November 6, 1918, a decided departure from the character of both parents as to time of maturity and relative sweetness. In 1919, only a few fruits were borne, and they were much later in maturing. A remarkable feature is the absence from the rind of any bitter principle or pungent oil, the rind itself being very mild and edible. With this character of rind, and the highly attractive color of the pulp this fruit would lend itself especially to the preparation of candied sections, rind and all being preserved in this form.

INFLUENCE OF POLLEN PARENT

The strong influence of the pollen parent is seen not only in the shape, size and exterior appearance of the fruit, but in the foliage characters. Like the Sampson tangelo, the leaves are broad and rounded, rather than tapering at the apex, and slightly constricted, giving a characteristic drawn appearance; the petioles are narrow, in which respect they are more like the orange than the grapefruit.

Figure 3 will give an idea of the character of this new fruit. While generally nearly round, the fruits vary somewhat in shape, some being slightly tapering at the stem end. The shape and size is influenced by its position on the bearing twig—whether

[1] The Sampson tangelo is itself a hybrid resulting from using pollen of the Dancy tangerine on grapefruit, and is a semi-loose-skinned fruit combining qualities of both parents in some degree—color of pulp and rind suggesting the tangerine, but the pulp being more like grapefruit in high flavor and acidity. It is a late maturing fruit, usually ripening from February to April.



A NEW TANGELO

A pink-fleshed citrous fruit created by hybridizing the Sampson tangelo and the grapefruit. Its unusual combination of characters makes it a rather remarkable hybrid; the lining and partition membranes are colored a reddish pink, and the pulp, slightly orange colored, is of grapefruit character but sweet, and the fruit apparently matures earlier than either of its parents. The fruits are about the size of an average orange. (Fig. 3.)

borne singly or occuring in a cluster. The average size is about equal to that of a fair sized orange—2¾ to 3 inches in diameter. It is usually flattened at the blossom end and this half of the fruit is larger than the basal half. The fruits in longitudinal section are usually somewhat asymmetrical or "lop-sided." The fruit in the illustration had nine segments fairly regular, and contained fourteen seeds (fruits usually averaging ten to twelve seeds). The rind is thin or of medium thickness (1/8″ to 3/16″); the core is small and solid; it is sometimes slightly open in fully mature fruits. The rind is of pale yellow color (Ridgeway's "Pinard Yellow" to "Primuline Yellow") with rather conspicuous oil cells.

One characteristic of the Sampson tangelo may prove of advantage in the rapid propagation of this type of fruit. Seedlings of the Sampson tangelo have been found to reproduce the original type almost without exception, probably because of the seed being formed parthenogenetically, i.e., without fertilization of the ovary. The seedling thus becomes like a bud from the mother plant, a characteristic that has become apparent with a number of Citrus hybrids when grown as second generation seedlings. Seedlings of this new hybrid are being tested out to determine its behavior along this line.

It is desirable to test out its productiveness, quality and season of maturity on different stocks, and arrangements have been made to do this in several typical citrus sections in Florida. However, until such tests have been made, the new fruit is not to be recommended for grove planting. The unusual combination of characters shown in this hybrid, and especially the occurrence of color in the lining membranes and in the rind (though absent in both parents) renders it worth preliminary notice at this time.

If found worthy of further propagation, a suitable name will be assigned to this new fruit.

Protoplasm in Motion

Ameboid Movement, by Asa A. Schaeffer, Ph.D., professor of zoology, University of Tennessee. Pp. 156, price $1.75. Princeton Univ. Press, Princeton, N. J., 1920.

Few animals have played a larger part in biological history than the ameba. Its activities illustrate the operation of the animal mind and body in a simplicity that can hardly be surpassed, while the philosophical evolutionist sees in this humble organism a supposedly close approximation to the earliest ancestor of the animals, man included.

One of the problems that has been widely studied, largely in a theoretical way, is the ameba's method of locomotion; because the same type of locomotion is found widely diffused among animals. Dr. Schaeffer has made extended observations on the streaming of protoplasm in the ameba, and in an interesting little monograph he presents the results. "The wavy path of the ameba represents a projection on a plane surface of a helical spiral"; it is not random but orderly. And "the spiral path is not an acquired habit," it "is supposed to be due to an automatic regulating mechanism which is present in all moving organisms"; moreover "the mechanism is one that attaches to the fundamental structure of protoplasm rather than to the gross morphology." It follows that "all organisms without orienting senses or equilibrating organs, or animals possessing such organs which are rendered ineffective by some means, will not move in straight paths nor in any kind of irregular path, but in orderly paths." The diagrams of paths followed by blindfolded men trying to walk in a straight line illustrate this point fascinatingly.—P. P.

THE PEJIBAYE
A NEGLECTED FOOD-PLANT OF TROPICAL AMERICA

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and
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IT IS, perhaps, permissible to characterize the pejibaye or chontaduro as a tropical American counterpart of the Oriental date palm. Both species are capable, almost unaided, of supporting life, as proved by Arab tribes which utilize the date as their principal food, and by the aborigines of southern Costa Rica and certain regions of northern South America, who subsist almost exclusively, during part of each year, upon pejibayes. There is, however, this noteworthy difference between the two fruits: sugar is the principal constituent of the date, while starch is the most important nutritive element in the pejibaye.

In Costa Rica the pejibaye has been cultivated by the Indians, principally those of Talamanca and the Atlantic slope, since remote antiquity. Evidences of the important rôle played by this plant in the economic life of the early Costa Ricans are to be found in the accounts of the Spanish historians. In the lowlands of Colombia, Venezuela, and Ecuador it forms a staple foodstuff of numerous aboriginal tribes. The Jibara Indians of Ecuador hold the fruit in such esteem that the ripening season is celebrated annually by a feast of several days' duration.

It seems remarkable, therefore, that this palm, which not only attains great economic importance throughout a considerable portion of tropical America at the present day, but whose value was recognized by Europeans in the first years of American colonization, should not have become widely distributed. Undoubtedly it can be grown successfully in many parts of the tropics, yet its cultivation, as an economic plant, is now limited to that region which lies between the Lake of Nicaragua on the north and Ecuador on the south.

ORIGIN AND NOMENCLATURE

Regarding the native home of the species, Henri Pittier (Plantas Usuales de Costa Rica) says: "The Indians have cultivated it since a remote day, and it is not known as a wild plant; wherever it is found isolated, it may be considered to mark the spot of a former habitation." This refers, of course, to Costa Rica. In Panama it has the appearance of an indigenous species, growing wild commonly in the forest, and to our personal knowledge the same is true of Colombia and Ecuador. In the latter country it is called *chontaduro* and *chontaruru*, a term taken from the Quichua language; in Colombia the name is *gachipaes*, *cachipaes*, or commonly *cachipay;* while in Venezuela it is known as *pirijao* (Carlos Cuervo Marquez: Tratado Elemental de Botanica). Botanically the species is usually listed in Costa Rica as *Guilielma utilis* Oerst. *Bactris utilis* is a synonym. While we cannot be certain, we believe the plant found in Venezuela, Colombia, and Ecuador,

Note.—Lest someone should be led to discount the enthusiasm of the agricultural explorer, (who declares the pejibaye is as delicate and delicious as the chestnut) with the remark that "he was probably very hungry," I cannot refrain from adding this note to say that Mrs. Hamilton Rice who accompanied Dr. Rice on his expeditions into the wilds of Colombia, told me that in her opinion it was one of the most delicious of all the tropical fruits with which she became acquainted in South America.—David Fairchild.

A TROPICAL AMERICAN RIVAL OF THE DATE PALM

The pejibaye or chontaduro grows in Costa Rica, Panama, and northern South America. Throughout this territory it is an important food-plant, occupying a position somewhat analogous to that held by the date palm in Arabia. The specimen here shown is in the garden of Don José Zeledón at San José, Costa Rica. Hanging from the tip of one of the leaves is a nest of the oropendula (Ocyalus wagleri) or social oriole. (Fig. 4.)

and which is described in the botanical works of those countries as *Guilielma speciosa* and *Bactris gachipaes*, is specifically identical with the Costa Rican *Guilielma utilis*: plants and fruits examined in Costa Rica, Colombia, and Ecuador appeared to us to be of one and the same species.

Pittier considers the name *pejibaye* (the form commonly used in Costa Rica) to be of South American origin, while Carlos Gagini (Costarriqueiñsmos) states categorically that it is a corruption of the Haitian name *pixbay* or *pijibay*. The word is written in various ways: *pejivalle*, *pejiballe*, *pixbae* and *pixbay* are all found in Costa Rican literature. The pronunciation is pe-hi-vȳ-e (*e* as in pet, *i* as in hither, and the final *e* nearly like the first). Gagini considers *pijibay* the most acceptable spelling, but *pejibaye* is the form preferred in the majority of Costa Rican publications.[1]

DESCRIPTION

The pejibaye palm is a pinnate-leaved species, reaching a maximum height of about 60 feet. Its straight, slender stem, commonly about six inches thick, is armed from the ground upward with stiff, very sharp, black spines about two inches long. These are arranged in circular zones of varying width, those near the base of the stem being four to six inches wide, while higher up the width decreases to one or two inches: there is about an inch of smooth trunk between the zones.

The leaves, which are graceful in appearance, especially when the palm is young, are commonly eight to 12 feet in length, and deep green in color. The rachis is provided with scattered spines.

The species is monoecious in character, staminate, or male, and pistillate, or female, flowers being produced upon the same raceme: the latter occur scattered among the former, and both are small, sessile, and yellow-white in color. The racemes, which are produced from the trunk of the palm immediately below or among the lower leaves, and are protected by erect spathes, are stout, and 18 to 24 inches long. The staminate flowers have six stamens arranged in three pairs opposite the lobules of the corolla; the pistillate flowers have an annular, leathery calyx, a small, round-campanulate, three-toothed corolla, and a trilocular ovary surmounted by three sessile stigmas.

The flowers usually appear during April, May, and June in the lowlands of Costa Rica, somewhat later in the highlands. The first fruits mature in September. From this month until March or April there are usually ripe fruits on the plant, provided the racemes are not cut when the first fruits reach maturity. The long time which the fruits will remain on the palm in good condition is a noteworthy feature of the pejibaye.

It is somewhat difficult to gather the fruit, because of the sharp spines which protect the trunk of the palm. Ladders may be put up, and the racemes cut and lowered to the ground; or, as is commonly done, the fruit may be knocked off with long poles.

Racemes of mature fruits sometimes weigh 25 pounds or more, and five or six such racemes are often produced by the palm in a single crop. The maximum production of one palm (or, more properly speaking, one stem, since four or five stems are often allowed to grow from a common base) is about 150 pounds of fruit. It is seen, therefore, that the productiveness of the pejibaye is similar to that of the date palm.

The individual fruits are top-shaped, conical, or ovoid in form, and vary from one to two inches in length. The base of the fruit is nearly covered by the green, leathery, three-toothed calyx. There is a wide range of variation in regard to the color of the surface, that of some varieties being clear light yellow, while in others the color is deep orange or reddish orange, sometimes shading to brown. The

[1] In English the inappropriate name of peach palm is sometimes applied to this plant.

A NEGLECTED SOURCE OF DELICIOUS FOOD

The raceme of seedless pejibayes which Don José Zeledón is holding at the base of the palm which bore them, weighs about 25 pounds. Four or five such racemes are produced by the palm each year. When it is recalled that these fruits contain as much nourishment as avocados, and far more than bananas, the relative oblivion in which the pejibaye has been allowed to remain during the four centuries which have passed since it was first noticed by Europeans, seems unpardonable. (Fig. 5.)

outer integument or skin is thin: in some varieties it adheres closely to the flesh, even after the fruit has been boiled, while in others it can be peeled readily from the boiled fruit. The character of the flesh is not easily described: it is dry, mealy, yet firm in texture, and pale orange to yellow in color. The single seed, from which the flesh separates very readily after the fruit has been boiled, is conical, somewhat angular in outline, about three-quarters of an inch long, black, with a thin but hard shell enclosing a white kernel resembling that of the coconut in character.

COMPOSITION AND FOOD VALUE

In the following table the chemical composition of the pejibaye is compared with that of several other tropical fruits of high food-value.[2]

TABLE 1. CHEMICAL COMPOSITION OF PEJIBAYE COMPARED WITH OTHER TROPICAL FRUITS

Name of Fruit	% Water	% Protein	% Fat	% Carbohydrates	% Ash
Guapinol (*Hymenaea courbaril*)	15.1	6.6	1.6	73.9	2.8
Pejibaye (boiled)	48.8	2.8	6.7	40.9	0.8
Banana	75.3	1.3	0.6	22.0	0.8
Avocado (Mexican) variety *Puebla*	66.3	1.8	26.6	6.6	1.5
Avocado (Guatemalan) variety *Sharpless*	71.2	1.7	20.5	5.4	1.1
Avocado (West Indian) variety *Trapp*	78.6	1.6	9.8	9.0	0.8

It will be noted that the figures given above for the pejibaye refer to the boiled fruit. In order to determine the amounts of the principal energy-yielding constituents in the ripe, uncooked fruit, one of the writers has made an analysis of such fruit, under the direction of Dr. Michaud of San José de Costa Rica. This gave the following result:

Starch	26.90%
Sugars	4.00
Fat	5.82

The energy-producing value of the fruits shown in the above table is also a matter of interest. That of the guapinol, as expressed in calories, is 1564; that of the pejibaye is 1096; that of the avocado, as determined by numerous analyses made at the University of California, varies according to the variety and the maturity of the fruit, from 600 to 1,300, with an average of approximately 1,000; while that of the banana is 459.

Of the several fruits here considered, the guapinol has the highest food value. Anyone familiar with this species, however, will recognize instantly that its fruit cannot be considered of economic importance. The guapinol is a leguminous tree common in tropical America: its fruit is a thick, short, hard pod, enclosing several large seeds and a thin layer of dry, yellowish pulp of a peculiar and not very agreeable odor and flavor. It may, in short, be

[2] The data concerning the guapinol, pejibaye, and banana are from a table published by F. Sancho, in the Anales del Hospital de San Juan de Dios (Costa Rica), 1917. Those for the three varieties of avocado are from the Manual of Tropical and Subtropical Fruits, by Wilson Popenoe (Macmillan and Co., 1920).

A BASKET OF PEJIBAYES, READY FOR EATING

These fruits have been boiled in salted water. In this state they are offered in the markets of Costa Rica, and are sold in large quantities at a relatively high price, the pejibaye being esteemed by all classes: it may, in fact, be termed one of the favorite fruits of Costa Rica, though the word "fruit" as applied to it in a popular sense is somewhat misleading, since the pejibaye is not sweet, nor acid, but resembles the chestnut in flavor and character. (Fig. 6.)

FRUITS OF THE COMMON PEJIBAYE, NATURAL SIZE

In size and character these fruits are typical of the pejibayes produced in Costa Rica, Panama, and northern South America. After they have been boiled in salted water, as these have been, the skin peels readily, and the hard stone is easily removed. The firm, mealy flesh is eaten without further seasoning of any sort. Its high food value is due to the considerable quantities of starch, sugar, and fat which it contains. (Fig. 7.)

A SPRIG OF SEEDLESS PEJIBAYES, NATURAL SIZE

This excellent variety is cultivated in Costa Rica, and may be propagated, like the date palm, by suckers or offshoots. The fruits here shown were grown in the garden of Don José Zeledón at San José. When ripe, the pejibaye will keep for ten days or more in perfect condition, hence its shipment to distant markets is readily possible. (Fig. 8.)

included among those fruits whose merits are summed up in the classical phrase, "relished by birds and children."

In food-value as expressed in calories, therefore, the pejibaye and the avocado stand first among the tropical fruits of economic value; some varieties of the latter have a higher value than the pejibaye, but the average is about the same.

The relatively small proportion of water contained in the fruit; the large amount of carbohydrates (mainly starch); the considerable quantity of fat; and the small size of the seed compared to the bulk of the edible portion, combine to place the pejibaye among the most noteworthy of the tropical fruits. And it is not only a fruit of high food-value, but it is delicious as well. We believe that it is destined to become a food-plant of great importance in many tropical countries, and it is in this belief that the present paper has been written, in order to bring the pejibaye to the attention of tropical horticulturists not yet familiar with it, and to place on record the available data regarding its culture.

USES

The pejibayes sold in the markets of Costa Rica have usually been boiled in salted water for about three hours. In this condition they are ready for eating without further preparation, except to remove the skin. They are so palatable in this form, that very few efforts seem to have been made by Costa Ricans to devise more elaborate methods of preparation, though enough has been done to show that this fruit lends itself to various uses.

After it has been boiled, the fruit cannot be kept in good condition more than five or six days. Before cooking, however, it has excellent keeping qualities. If placed in a dry room, where the air will have free access to it, the fruit will not decay, but will gradually dry up. If placed in a moist, warm room, fermentation may take place within a few days, and the fruit become useless for eating.

It should be a simple matter to ship pejibayes to distant markets. If properly packed, they should keep ten days to two weeks, at least, without suffering materially either in appearance or flavor. It may be mentioned, in this connection, that it seems feasible to dry the boiled fruit and store it for an indefinite period. An experiment made by Doña Amparo de Zeledón, based upon a suggestion of Carlos Wercklé, has given excellent results: boiled fruits were pared, the seed removed, and the flesh dried in an oven for several hours. The water was extracted but the fruit retained its form, color, and general character. It was found, six months later, that this dried fruit, when boiled for half an hour, regained the consistency and flavor of the boiled fresh pejibaye.

Like the chestnut, which the boiled fruit strikingly resembles in texture and flavor, the pejibaye is used as a stuffing for turkey and chicken. Dried, it might be reduced to a flour which would serve various culinary uses. But to one who has eaten the freshly boiled pejibaye, there is no incentive for seeking new ways of preparing the fruit for the table.

In addition to the fleshy portion of the fruit, the hard white kernel of the seed is eaten. It resembles the coconut in flavor, and contains a large quantity of oil. The *palmito* or terminal bud of the palm may be used as a vegetable, but its consumption necessitates the destruction of the palm. It cannot, therefore, be considered of much economic importance. The wood, which is dark brown in color, nearly as hard as bone, and takes a fine polish, was used by the Indians in pre-Colombian days to make spears, and for pointing their arrows. It is now employed for walking sticks.

CLIMATE AND SOIL

While the cultural requirements of the pejibaye palm are not fully known, various inferences may be drawn from

its behavior in different parts of Costa Rica. It is abundant in the southern part of this country, and in the central portion on the Atlantic side. On the Pacific side it is seen occasionally in the vicinity of Orotina and other towns. The principal center of commercial pejibaye cultivation in central Costa Rica is Tucurrique, 70 miles from Port Limón on the railroad leading to San José. Here there are regular plantations, made with the object of supplying the markets of San José with fruit.

The pejibaye is a plant adapted to tropical conditions, preferring a region where the rainfall is not excessive (100 inches annually, or less). Regarding its ability to grow at varying elevations, it may be said that it is more adaptable than the breadfruit tree. The latter rarely succeeds in the tropics at elevations greater than 2,500 feet, while the pejibaye fruits successfully in Costa Rica at all elevations from sea level to 4,000 feet, and is occasionally seen at 5,000 feet, though it is said not to fruit well in the cool climate of the latter elevation. At San José, where the altitude is 3,800 feet, excellent fruits have been produced in the gardens of Don José Zeledón and Don Alfredo Brade.

The region of Tucurrique, where most of the pejibayes marketed in San José are produced, lies at an elevation of approximately 3,000 feet, in the valley of the Rio Reventazón, This is a region of coffee, sugar cane, and banana cultivation, with abundant rainfall. The soil is a substantial clay loam, in many places almost a pure clay.

In the banana-growing district a few miles inland from Port Limón, at an elevation of about 100 feet above sea level, the plant is said to be a failure because of the excessive rainfall.

It is doubtful if the species will grow successfully in a cool subtropical climate such as that of southern California. In extreme southern Florida, however, there are probably regions where it will succeed. Concerning its behavior in this state, we have two reports. E. N. Reasoner of Oneco, Manatee County, writes as follows:

"I had *Guilielma utilis* years ago, two specimens 16 to 18 feet tall, which I sold to Mr. Thomas A. Edison, but they died from a cold wave shortly after being established at Fort Myers. I think it too tender for us, but it might succeed in Dade County or Palm Beach County."

Professor Charles T. Simpson, of Little River, Dade County, reports concerning his experience with numerous specimens: "I have tried them in pots, where they do fairly well until transplanted into the open ground. I have planted them in pine land and hammock with equally discouraging results. Edward Brown had a specimen in rich hammock which for a while did well, and attained a height of ten or twelve feet. It suckered freely, and I dug under it, made an incision, and placed a pot in which a fine sucker was soon established. This I later cut off and put in a similar position in my hammock, and for a while it did well. But it soon began to look badly, and finally it died, after I had rooted another sucker from it. I am under the impression that our soil disagrees with it. It ought to be tried down in the Homestead country, where, although there is lots of limestone, there is also a good deal of clay and iron."

In Cuba, Porto Rico, and the other West Indian islands it should find itself entirely at home, and we recommend it as a culture for these islands. In many parts of Brazil it should also succeed, while the Asiatic tropics undoubtedly offer immense regions where it could be cultivated to great advantage.

Three or four palms, grown in the dooryard with practically no expense, would mean the production of three or four hundred pounds of excellent food every year. And this would be a food of delicious character, available during six to eight months. With such possibilities, does not the pejibaye merit attention throughout the tropics?

A SMALL PLANTATION OF PEJIBAYE PALMS

This plantation at Tucurrique is one of the many which supply the markets of San José de Costa Rica with pejibayes. The plant is at home on tropical mountain slopes at elevations up to 4000 feet above sea level. It comes into bearing when six to eight years old, and its life is not less than 50 to 75 years. (Fig. 9.)

CULTURE AND VARIETIES

When grown from seed, the pejibaye comes into bearing at an age of six to eight years, and its life is considered to be 50 to 75 years, or perhaps more. These figures are for the tropical lowlands, *i.e.*, regions below 3,000 feet in elevation. At higher altitudes the coolness of the climate retards the development of the palm, and it may not come into bearing until it is ten or twelve years old.

In commercial plantings, pejibayes should be spaced 20 feet apart. Carlos Wercklé considers that the best system is to allow two to four suckers to develop around the base of each palm, thus forming a clump of three to five stems. Suckers invariably develop after the palm has attained a few years' growth. Some of them may be removed to extend the plantation. It is, in fact, solely by this means of propagation that pejibaye culture may be placed upon the best basis, and for the following reason: the finest varieties are seedless, and must therefore be propagated by vegetative means.

Wercklé states that the best time to remove suckers is when they have attained a thickness of about three inches at the base, and are four to six feet high. At this time they have formed roots, and are easily cut from the parent and established independently. The leaves should be cut back heavily and the plant shaded until it has had time to form new roots; and it must also be supplied abundantly with water during this period.

Regarding the quantity of suckers or offshoots which can be obtained from one palm, it seems probable that the number will not be less than eight or ten. In the few instances where pejibayes have been propagated by this means in Costa Rica, no records have been kept. It is possible that more than ten may be obtained, since the removal of the first offshoots produced may encourage the palm to develop others.

Seed-propagation is the method commonly employed at the present time. The seeds, like those of numerous other palms, are killed if left to dry for a long time in the sunlight. If removed from the fruit, dried in the shade for a few hours, and packed in slightly moistened powdered charcoal, pulverized coconut fiber, or a mixture of charcoal and coconut fiber or charcoal and chopped sphagnum moss, they may be shipped around the world without difficulty. They may be germinated in a mixture of coconut fiber and sand; or in light soil containing an abundance of humus; or they may be stratified in sphagnum moss and potted-off after they have germinated. Wercklé recommends the last-named method, and states that germination takes place in about two months. He notes that care must be taken to keep ants away from the young plants: he has at times lost many through the attacks of these insects, which destroy the first shoots as they emerge from the seed.

The varieties of the pejibaye generally recognized in Costa Rica are few and ill-defined. In other countries where the plant is grown, practically no attention is given to this subject. Costa Ricans speak of the *pejibaye rayado* as the best. This is simply a form in which the fruits are marked by longitudinal scars, and is not a well-defined race or strain. There are pejibayes of varying color and varying form and size; and most important of all, there is the *pejibaye macho* or "male pejibaye," a seedless form. This is a fine large fruit entirely devoid of seed (though Don José Zeledón states that it is common to find on each raceme five or six fruits with seeds in them). Numerous palms which produce these seedless fruits are known in Costa Rica, and some are said to have been propagated by offshoots; but the cause of seedlessness in this species has not yet been determined, and it does not seem altogether certain that the characteristic is one which will, in every case, be inherited. It may be connected with the pollination of the flowers, and some of the palms which

produce seedless fruits in San José might bear fruits containing seeds if transplanted to the lowlands. The subject requires further investigation.

Even in the ordinary forms, however, the seed is not sufficiently large to be objectionable, and since the flesh separates from it readily (after the fruit has been boiled) the seed is not troublesome to one eating the fruit. It is desirable, of course, to plant seeds of a good variety, since there are some which are decidedly inferior: but beyond this nothing is required to make seedlings sufficiently satisfactory to warrant their being planted on a large scale.

In conclusion, we wish to urge upon horticulturists in tropical regions where this palm is not yet cultivated, the desirability of its introduction and establishment as a common dooryard tree; with a view, later, to the extension of its culture, so as to place the pejibaye upon the substantial basis of a profitable commercial fruit, a position which we confidently predict it will achieve if the necessary initiative is supplied to effect its preliminary planting and study.

MILK PRODUCTION OF YOUNG COWS

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The question is often asked as to how much more milk will a mature cow yield than a two-year-old cow with her first calf. In other words, if a heifer produces 6,700 pounds of milk and 360 pounds of butterfat during her first year's milking, how much will she yield as a mature cow, and at what age will she mature, or at what age will she produce the largest quantity?

To determine this matter I studied the yearly official test records of 865 Jersey cows, so my work relates only to that breed, although it holds good in a general way for all dairy breeds.

From the table below it is found that a heifer that produces 6,700 pounds of milk and 360 pounds butter-fat as a two-year-old will yield 9,000 pounds milk, and 480 pounds butter-fat as a mature cow, at seven years of age. But she becomes over 90 percent as efficient at four years old, or practically mature with the third calf. Apparently the cow will hold her maximum efficiency through her tenth year.

We find also from this table that young cows gain an easier entrance into the Register of Merit than old cows, and this is true with all dairy breeds. To prove this statement we will call attention to the fact that six-year-old cows exceed two-year-old cows by 101 pounds fat, or by 23 per cent, while the standard for entrance into the official test book has a difference between these ages of 110 pounds (250 pounds for 2 year-olds and 360 for five years and over) or 30 per cent. To state it differently, a two-year-old exceeds her requirement by 30 per cent, and the six year old excells hers by only 22 per cent. But the error is not a serious one.

The records are as follows:

Production of Young Cows Compared with that of Mature Cows

Age of Cow	Number of Cows	Milk	Per Cent	Butter-Fat	Per Cent
		pounds		pounds	
1 year	86	6267	68	337	71
2 "	278	6707	74	359	73
3 "	126	7496	82	399	81
4 "	112	8231	91	449	94
5 "	91	8222	91	441	92
6 "	60	8490	94	460	96
7 "	47	9029	100	477	100
8 "	29	8755	97	462	97
9 "	25	8718	97	476	100
10 "	11	8887	98	464	97

CITY AND COUNTRY—II

Effects of Human Environments on the Progress of Civilization[1]

O. F. Cook

Bureau of Plant Industry, U. S. Department of Agriculture

THE city needs to study the country and the country the city, instead merely traditional, conventional ideas being accepted on either side. Individual interest or preference for the city or the country should not keep us from seeing the different sides of the practical questions.

The relative advantages of urban and rural life have been debated for centuries with no better prospect of a conclusion being reached than in other questions of taste and habit. It means little in itself that country people generally prefer to live in the country and city people in the city. All primitive people believe instinctively that their own life is the best. The naked savages wandering in murky tropical forests, the Arabs in their desert sands, and the Esquimaux in their snowfields, are as firmly convinced as any civilized man that their special way of living is the most to be desired. To prefer what we know and to dread everything else, is the instinctive attitude of the mind. The narrower our existence becomes, the more difficult it is to diverge from the routine path. To break with one's habits, as the French say, is regarded as a supreme misfortune. The instinct of self-preservation that ties us so strongly to life also makes our own existence the standard of individual preference, which we assume that others should share, even against their will.

LABOR AND CAPITAL CONCENTRATING IN CITIES

Cities present many "attractions," to get more people to come in and contribute their money or their labor, so that industries, business and property values may increase. This is natural and inevitable, seeing that cities are not self-supporting, but must draw upon the country. The industrial excuse for large cities is becoming less, with improved facilities of communication and electric transmission of power, but people are crowding into the urban centers faster than ever, and no devices are spared to "keep them coming." "Get ready for the Big City now," as the porter says when the train approaches Los Angeles. Instead of finding ways to resist or to counteract this movement, remission of taxes is being asked, to stimulate the building of tenements, especially in the largest cities.

Continued dominance of urban ideas means that we shall become more and more urbanized, that capital and labor will concentrate more and more in cities, and that rural population and production may soon enter generally upon the stage of decline which many districts are showing. In the last ten years urban population has increased more than seven times as fast as rural population. With two-thirds of the people of the United States living in the cities and towns, the time certainly has come for considering the remnant of farm population, instead of continuing to subsidize urban development at the expense of agriculture. The reasons that have justified tariffs and other direct advantages of urban industries in the past are still applicable to particular cases, but their general purpose has been attained and over-shot. A vast industrial system has been established, and we have gone beyond the equilibrium of agriculture, manufactures and commerce that statesmen of former generations considered essential to our independence.

Tariffs protect against foreign competition, but leave the farmer fully exposed to urban exploitation. War-

[1] This is the second of the two articles on this subject by Mr. Cook, the first paper having appeared in the previous issue of the JOURNAL. The italics in this paper, as in the first, are the editor's.—*Editor.*

time disturbance of values has accelerated industrial expansion and a luxuriant growth of commercial parasitism draws support from the public in high cost of living. Fifty millions a month was the estimated levy of the food speculators on the American public in the war period. When sugar prices began to decline in September, 1920, a quarter-billion "loss" was announced in the speculative "value" that was being collected from the public. Half a billion is the estimate of purely speculative "securities" marketed annually in the United States. The taxes on war profits and excess profits also show something of the extent of the urban abuses that have been allowed to develop, and point to the need of an improved commercial system, not subject to these parasitic excrescences.

DANGERS OF INDUSTRIALISM

The war should have taught us the weakness and danger of urbanism, but the effect has been to drag us closer to the pit that the European nations fell into. That we have more land than the industrial nations of Europe, will not save us if we abandon farming for urban pursuits. "Going back to the farm," is an urban delusion. Many may cherish the hope, but few can attain it. People who are once thoroughly urbanized and habituated to a routine existence are disqualified for rural life. They do not go back to the laborious, complex, and exacting responsibility of farm work unless they are forced by illness, famine or other catastrophe, as in Central Europe where urban industries are being abandoned.

Instead of our national interest being aroused to maintain agriculture, urban industrial development is being pushed forward to occupy the foreign markets in advance of the reconstruction of Europe, with the excess-profits tax working as an endowment or enforced subsidy of enterprises that have thriven most during the war period. In spite of the danger being recognized, no effective measures have been devised to keep the remainder of our farm population from moving to the city—to live on Argentine beef, New Zealand mutton, German potatoes, and Danish butter. In a few years our supplies of food and essential raw materials may become as precarious as those of industrial European countries, and subject to the same danger from wars of industrial competition. The loss to our European race of 35,000,000 people in the recent struggle for industrial supremacy gives no pause to our Gadarene madness. The nations are bedeviled with the idea of exploiting each other, instead of cooperating in the development of a common civilization.

WHY "BUSINESS FARMERS" GO TO THE CITY

Financial experts who see the limits of our present course are urging as "a matter of vital necessity that the efforts of the farmer be supported and stimulated . . . to warrant his staying in the business of farming." Formerly it was assumed that the farmer who made a living should be content, but a new idea of larger returns to the farmer is being expressed, even in urban editorials. "Still, there must be farmers; and farmers must have help; and help enough must be found to make farming profitable." That profits come from the "help" reflects the urban idea that wealth must be got *by exploiting somebody*, but there is no way to keep the help on the farms, or the farmers either, as long as the urban wages are higher, the work lighter, the hours shorter, and the "attractions" brightly painted.

In trying to protect himself against urban exactions, the farmer has become more of a business man. Some writers have hoped that broader business experience would furnish the key to the agricultural problem, but a frequent outcome for the individual farmer is to move to the city and become a middle man himself. Applying urban standards of profit, the farmer decides that he is losing money by staying on the farm. Agricultural

journals abound in comparisons of farming with urban business, leading to one conclusion. "The farmer is operating his business at an actual loss and that is the reason he is quitting the farm." "He knows that he is not getting paid in proportion to the capital, energy and brains he is putting into his business." "The building up of a farm business is the hardest and the most precarious undertaking in the world today." "No other business on earth can stand the handicaps which confront the farmer." "The American farmer today is the most burdened, perplexed and over-worked member of society." Instead of certain percentages of profit being guaranteed, as in many urban undertakings, the farmer has no assurance of even a wage return for his labor. He finds it impossible to agree with Thomas Jefferson, that "The pursuits of agriculture are the surest road to affluence." Now it is the farmer, rather than the factory worker, who feels himself "Condemned, like Sisyphus of old, to roll the stone of labor up the steep acclivity of life."

One writer has discovered from the income-tax returns that " . . . of twenty-two selected occupations the farmer's class contributes least in the aggregate, although it is numerically the largest class in the country." Agriculture, according to this leader of finance, is "a great industry exempt from the excess profit and war profits tax and apparently not effectively reached by the income tax." Instead of being impressed by the unprofitable state of agriculture, the financier argues that the system of taxation must be unfair, and asks whether "the politicians . . . would not devise means to lay an effective tax if the same situation existed in a business industry?"

GROWTH OF DEPENDENCE IN CITIES

As yet there is no control or limitation of the number of people who are allowed to engage in profit-taking "industries," nor of the extent of their exactions. Predatory commerce and finance, in their effects upon agriculture and other producing industries, are more injurious to the public than many of the forms of gambling that have been prohibited by law. *Why should it be considered a natural right to stop producing and go to taking profits or drawing support from the urban rake-off?* For the protection of the public, licenses are required for many kinds of urban business, and this policy could be extended to prevent over-crowding of urban occupations, and much needless parasitism and dependence in cities. To permit unrestricted entrance to the nonproductive "business industries" is like allowing any applicant to begin drawing a pension. The pension system would break down, of course, like the "business industries."

Whether we say that all unnecessary middlemen are parasites, or that all unnecessary costs of handling and marketing are parasitic, the tax on the public is the same, and there is the same need of improving the commercial system, to *stop the present leakage between producers and consumers.* How to eliminate the middleman is being discussed, too often without understanding that a better commercial system must be developed. Profiteering, as we now call it, is nothing new, except that the large-scale operations of recent years have produced the new reaction that the word symbolizes. The stage of exasperation is reached when farmers see no recourse except to go on strike and reduce production, like urban industrial workers. Radical agitators flourish in rural communities, and some of the more primitive elements take to night-riding and burning of tobacco-barns and cotton-gins, to retaliate against "the system," and those who profit by it or weakly support it. In the words of a conservative farm editorial, "The people of the United States might as well accept it as a fact that producers have acquired a class consciousness."

In some respects the feeling among farmers may be compared to that of the Revolutionary period when the American Colonies separated from

Great Britain—the feeling of protest and revolt against commercial exploitation and control by those who do not share the burdens of agriculture, nor understand its problems. Throwing a cargo of tea into Boston Harbor was a lawless escapade, but marked a change in the temper of the Colonies, as historians have reflected. The analogy, of course, is not to be followed in the direction of political separation of the country from the cities. The mutual relations of agriculture with industry and commerce, as parts of our national system, are obvious, and the need of keeping the parts in practical adjustment, if the system is not to be impaired.

STABILIZED MARKETING SYSTEM NEEDED

The recent war-time prosperity of farmers did not mean that the tendencies of our system had changed. No mere flurry of high prices and "good times," but a thorough readjustment of economic, social, and rural welfare conditions is needed, to make farming as profitable, as safe, and as stable as urban business. A prosperous turn to farming, by making it easier to sell land, serves at first merely to facilitate the movement to the city, among those who have been waiting for chances to go. What has to be recognized and corrected is the general effect of our present system to penalize and discourage farming by making country life more difficult and precarious than living in the city. The farmer will have a dependent status as long as the merchant has the life-and-death power over prices, without regard to the interests of agriculture or of the consuming public. An irresponsible commercial system is sure to abuse its power, like an irresponsible government, or a parasitic military caste. Taking advantage of war-time conditions to collect double or treble profits must be reckoned as an abuse of commercial power.

Perishable products have more acute reactions of supply and demand, but no practical reasons have been discovered for the very wide fluctuations in the prices of imperishable products like cotton. Since it is possible to know in advance the kinds and quantities of fiber that are needed, and to approximate the costs of producing, transporting and storing a normal crop of cotton, a practical marketing system might be worked out, at least to the extent that farmers who raise normal crops would not be forced to sell for less than the production costs. The natural consequence of making business more profitable than production is to have *too much business and too little production.* Business depressions alternate with business inflations, for lack of adjustment of the commercial system to the needs of production. Stable prices and a steady flow of trade are in the interest of producers and consumers, but speculators must buy low and sell high, to get their profits. Speculative dominance of markets turns the whole system of trade into an agency of exploitation. That "business confidence" is so important a factor in the prosperity of agriculture or other producing industries, shows how precarious our system is, how completely it is built on the sand of speculation. The farmers do not get good prices for their cotton unless the urban speculators are taking chances that cotton will go still higher!

SPECULATION REACTS ON PRODUCTION

Over-exploitation, rather than over-production, is to be considered as the cause of urban panics and agricultural crises. When business over-reaches too far, the "demand" is suppressed. Excessive profit-taking interferes with normal consumption, and production gets a needless set-back. Speculative derangements of the commercial system discourage farmers and restrict production no less than root-rot or boll-weevils. That we do not produce enough sugar, oil, wool, or long-staple cotton for emergency needs, was recognized as a national danger during the war. How to protect agriculture against speculative boat-rocking and mob-psychology in urban markets, may be learned in time, and how to dis-

tinguish predatory profits from legitimate returns for the labor of production and distribution. Fixing of prices may not be feasible, but relative values of different products may be recognized to avoid the dangerously artificial "values" that speculation develops. With markets once stabilized, we would look back to our present commercial vicissitudes as not much better than trading cotton bales for lottery tickets.

Improving agriculture by lending more money to farmers is another urban remedy, more specious than practical. How shall credit facilities be equalized while farming remains precarious and unprofitable in comparison with urban industries? Many farm products are too perishable to serve as security for loans, and even an imperishable article like cotton is subject to speculative impairment of value. Too much credit is given for speculative farming, to those with little knowledge or judgment, who rush in to make fortunes from high-priced crops. The financial risks of such undertakings are not good, and regular producers are injured by having their markets destroyed or stampeded Loaning and speculating are "business industries" that are easily overdone, and sap too much from production. Not a larger use of credit by farmers, but *less need of borrowing money and paying interest* would mark a real improvement in the economic status of agriculture.

The relations of city and country are becoming acute because the city has so many new ways to reach out to the country. Urban propaganda have gained an enormous momentum. Even farm papers are published in cities, and draw rural apostles to town. In primitive times, with facilities of communication undeveloped, urban parasitism could destroy only neighboring populations, but modern cities draw supplies and people from remote regions. Tendencies that under more primitive conditions would work out in centuries may now become effective in decades.

ROME FELL WHEN ITS AGRICULTURE DECAYED

It is the way of civilizations to become urbanized, and of city populations to lose touch with agriculture. The farm is where we climb up the scale of civilization, the city where we run down. Our nearest analogy is with Rome, an imperial republic that outgrew the older nations and centered the activities of the Mediterranean world. Liberty enlightens and energizes, but with progress more rapid there is more danger of running completely off the track. In the constructive phase of their civilization the Romans were devoted to farming, but agriculture decayed in the period of political and commercial expansion. "For many centuries war and the cultivation of the soil were regarded as the only occupations befitting a free-born citizen." Yet a few centuries of urbanism wrought complete destruction. The Roman agriculture had a family organization at first, slavery during the period of foreign conquest in the late republic, and tenant-serfdom in the stage of imperial decline.

Cato and other patriotic statesmen foresaw the ruin of the Roman system when agriculture began to decay. Augustus and Maecenas were at pains to enlist the talent of Virgil and Horace, to secure the most attractive expression of the rural traditions and ideals of the nation, and lead the currents of thought away from the city. Remedial legislation in many forms was attempted, and especially to attract tenant-farmers to the public lands, but production and population continued to decline. A fever of speculation ravaged the Roman world in the last centuries of the republic, and added to the devastation of the civil wars. Feeding and amusing the urban proletariat became the chief tasks of the government, until the whole parasitic system broke down and was swept away by the northern barbarians.

That our age is more scientific—more inclined to investigate and recognize facts—should give us better

prospects of finding safe courses and maintaining our civilization, unless we drift too far before beginning to take thought of agriculture. Painting "The Man With The Hoe" inspired an eloquent protest in verse, but literary powers of projection need also to be used constructively. Not indignation over past "wrongs" or primitive limitations, but a spirit of clear intelligence and practical human interest needs to be inspired, if we are to find the way out.

THE TOLL OF CITY LIFE

Food to maintain our cities is not the chief concern. Urban populations are transitory, even if supplied with food. Withdrawing the rural population is worse than destroying the city, because *the life of the nation is in the country.* Families seldom last more than two or three generations under urban conditions. The lowest birthrate is in well-to-do urban families. If only the weaker and less capable were eliminated, a beneficial eugenic function could be claimed for the city, but even the best stocks deteriorate in the urban environment. The rich and "middle-class" families are eliminated even more rapidly than the poor. Thus the natural rule of survival of the fittest does not apply in urban selection. Putting all the presentable young women on the stage and choosing the strong, alert, prepossessing young men to serve the public as retail tobacconists or haberdashers' assistants may be good business, but certainly it is not in the interest of the nation and the race! Eugenic regulation of urban employment may be far ahead, but with an enlightened public sentiment able-bodied and right-minded young men would be shamed from spending the years of vigorous youth in work that can be done by old men or cripples. "Our boys are mad with the city," and many urban "industries" are spreading this contagious insanity.

War is condemned for reasons of eugenics, because the strong men are taken and the weak left at home, but *the city destroys whole families.* The process of selection and elimination is repeated in each generation—bright boys from the country becoming successful merchants, wealthy bankers, or great captains of industry, but usually leaving few descendants, and these in artificial environments of wealth, luxury and parasitism. Urban employers prefer boys and girls from the country, as being more responsible, resourceful and adaptive. The recent arrivals prosper, while the mass of urban populations is crowded gradually into the discard. Continual drafting of the more capable stocks to the city is a process of adverse selection, leading inevitably to deterioration of the race and to decay of civilization. "For it has been heretofore always the case that men under the influence of civilization, though at first improving, afterward degenerate." Agriculture is the root of civilization, and the plant dies when the root decays.

Urban conditions no doubt are the more destructive because our northern races are not accustomed to cities, which came late into Europe, through the Oriental contacts of the Greeks and Romans. Only the Jews, with their strong family and religious organization, have been able to sustain through the centuries an urban existence. Preference for cities may be traced back to the Oriental idea that labor is a curse, and money the chief blessing, to buy leisure, luxury and social standing. Primitive defects of human character become dominant again in cities, the family organization of society is dissolved, and we are back in barbarism. Greed, vanity and display are the social growths of urban soils, that bear the poisoned fruits of envy, hatred and revolt. Ostentation is the veritable seed of anarchy. The barber gets a "close-up on society" at the horse-show, and is ready to throw bombs.

City people, of course, are not all urbanized, or to the same extent. Some are country-life enthusiasts, with zeal intensified by a sense of privation. The hope of being able to live in the country is the mainspring of many

city lives, as of country people to retire to the city. Many families spend their summers in the country, and maintain their interest in out-door life and farming. Families that break the rural contacts are at a greater disadvantage in the city, and the sooner obliged to choose between the suburbs and the slums. The city does not fill up and flow back to the country. The current may slacken at times, but never stops. As a net result of urban striving the cities are richer but the race poorer, and less able to maintain the structure of civilization. It should not surprise us that hygienic surveys are showing larger percentages of deformed or abnormal children in country schools than in neighboring cities. With the best blood sapped away in each generation, it must be expected that only a remnant of persistently rural-minded people will be found in the country, and a residue of the inert, incapable or defective. After the wheat is harvested, the weeds grow!

OUR MOST FUNDAMENTAL PROBLEM

If the adverse selection of the city is beginning to show definite lesions of inferiority in the country, the problems of urban parasitism may receive more intensive study, and the ways of reversing the present tendencies, so that the more capable elements of each generation may remain in the country and raise families, instead of going to the city to be eliminated. There is no real competition or conflict of interest, since the city also is menaced if the rural population is impaired. *More fundamental than any other issue is that of conserving superior race material for rural progress*, instead of having our best boys and girls drafted into the city to be entangled and lost in the "jungle" of urban exploitation, industrial, commercial, and financial, or even in "rescue work." Urban misery cries from between the millstones, but the grinding goes on, in spite of philanthropy or revolt. Urban interests have exploited each other and scrambled for the fruits of agriculture from the beginning of history.

As long as we think of agriculture merely as tributary to the city, neither the farm problems nor the problems of labor and capital are likely to be solved, or even understood in their essential relations. Work that is exploited is also despised. Agriculture must be appreciated and developed, not for urban exploitation, but as *the normal life of civilized people.* The first step is to escape the urban prepossessions, by seeing that agriculture is fundamental and deserves primary consideration for its own sake, because it has richer rewards of satisfaction for the normal human instincts, and a larger outlook to the progress of civilization and the welfare of the race. In the words of Washington: "Agriculture is the most healthful, most useful, and most noble occupation of man." And this, we need to see, is not an out-grown sentiment, but living wisdom, for the present and the future. Leaving the land for the city is turning away from life. Education should teach us this, and how to live in the country. Ideals have first to be humanized, before the problems can be studied with constructive insight.

The Progress of Research

Those who sometimes feel impatient at the apparent slowness of research work should visit the fields and laboratories where the work itself is being conducted, and they would appreciate this reply which came to one of the JOURNAL's recent requests for a report on a special investigation: "It is true that I am collecting extensive material on ————, but I am not at this time ready to make even a preliminary report on the subject. I may possibly have something for you in this line two or three years later."

VISIBLE RECORDS OF HEREDITY

Lack of Photographs of New Hybrid Forms an Irreparable Loss to the World

DAVID FAIRCHILD

THE experience of the past seven years in the conduct of the JOURNAL OF HEREDITY has shown most conclusively a pathetic short-sightedness of many research workers in the gathering of those most useful of all things, the photographic records of their work.

It is not uncommon to find that a breeder has worked for years; has produced a host of most interesting forms, and at the last moment, just as he sees them going out of flower or fruit, has sent a boy with a kodak to photograph them. All the visible record of his work the boy must try to squeeze into the space of a three and a quarter by four and a quarter film. The result is that when the research man comes to show his results to the interested public he fails completely. He cannot describe the forms which have disappeared or which, like a comet have gone for a whole year. He can only say to his friends, "If you could only have seen them;" or, "If you could only come in May and see them again."

One of the most prominent men in the field of animal genetics said to me the other day he had often wished he had taken photographs as he went along, so that now he could portray the changes which have taken place in his guinea pigs. And all of us could add similar instances.

If we research men would put a small fraction of the time which we devote to getting our results, into a study of how to photograph them adequately so that they will show just what these results are, our work would be immensely benefited by the effort.

The world will look at pictures. It can understand those that are properly made and that are large enough to see easily. It will not take the trouble to imagine in a tiny kodak view the details which the research man can see plainly because he knows before he looks at it what to look for.

I believe it is a mistake to depend upon a professional photographer to get what one wants shown. He cannot have your point of view and is trying for something else—a pleasing effect. He almost involuntarily does this. It has taken us years of painstaking work to educate the official photographers in the Department of Agriculture to get what we want portrayed, and an inexperienced man cannot get what you want. Put your own head under the black focusing cloth and arrange your own photograph.

But in getting scientific accuracy don't forget that the professional photographer was right too—you must make your picture attractive to give it the greatest value.

The background of a picture is of great importance in making it attractive. An ugly fence or the bare side of a house or barn will spoil the looks of any photograph.

Remember that it is the unusual point of view that attracts. Remember that the near view is usually more striking than that taken from a distance. Remember that it is not necessary to show all of an object; the eye will complete it just as it does a fragment of a landscape.

Perhaps the very most difficult thing to show in the photograph of a fruit or flower or small plant is its size. It is quite common to put a measuring stick in the photograph, or a surveyor's pole, or to try to give scale by a cane stuck in the ground, or a man's hat or a jack knife laid on the table. Curiously enough, these things not only ruin the beauty of the picture but fail to give an idea of the size. It takes a conscious effort on the part of the observer to translate it. He says

to himself, "A cane is about three feet long—this little tree is taller than that, yes it must be about four feet high, and that would be about so tall," and measures the height with his hands. If a child had been standing by the little plant or a dog or domestic animal of some sort, the approximate size of the plant would have been realized unconsciously, regardless of the fact that one does not know the size of the child or dog.

There are of course cases in which absolute accuracy is desirable, and in such photographs a scale at the very edge of the picture may be necessary, but ordinarily the general impression must be depended upon to give the size, for the general reader does not stop to analyse a photograph. A scale photographed at the edge of each photograph which can be cut off when it is used for other than record purposes is of course an excellent precaution though in most cases a statement of size is just as good.

If you pose a man or woman for a scale, be sure to have an attractive one, though don't do as one person I know did. He asked such a beautiful girl to hold his fruit for him that no one looked at the fruit at all! On the other hand, thousands of remarkable photographs are ruined by the hired man in his glaring white shirt sleeves; and a hat thrown on the ground, for some reason or other seems to distort most photographs of plants or animals. One wonders perhaps why the man put his hat there.

The careful use of part of a human figure can be made to give scale, but it must be very carefully done; to ruthlessly chop off a man's head in a picture gives the reader something of the same kind of a shock that the photograph of a detached arm does in a medical publication. Don't do anything that will deflect the attention from the object to be shown. If it is a small object, get close to it and make it cover a large part of the plate. If some one must hold it, show him looking at it in an interested way, and the eye of the reader will follow his gaze, but don't unbalance the picture by putting too much of the man in and too little of the object. Human eyes staring at you from a photograph will always unbalance it. You must meet them unconsciously with yours and fail to see the object which the photograph was taken to show.

There seems to be some relation between the size of the object and the amount of the background space around it. If this space is little, the impression of largeness is given. A cherry which is enlarged to nearly cover a 5 x 7 plate looks as large as a pumpkin, and yet the enlargement is only 3 diameters while a pumpkin occupying the same space on a 5 x 7 plate gives a confused idea of its size though the object is shown only $\frac{1}{8}$ its natural size. There is a mysterious psychological relation here which I wish some one more skilled than I am in such matters would explain. By trial and a study of the effects, one can get approximately the right proportion, so that one unfamiliar with the object gets at a glance a reasonably correct impression of its size.

Remember that in the almost microscopic details of a head of wheat or a hairy leaf are to be found fascinating forms which to the layman are new. There are few less interesting photographs, however, than those of a whole wheat head with its long awns because it has to be so small that it appears,—well, it appears to be nothing but a head of wheat,—whereas the fascinating richness of form to be found in a head of wheat is well known to every hybridizer of this important cereal. The public at large is still puzzled to tell a head of wheat from a head of rye or barley. Get enlarged photographs whenever they will show the new point to be illustrated and devise new methods of showing off the old forms. A photograph of a cow for example, to the layman is nothing but a cow, but a cow's udder or tail he has probably never seen photographs of. While small photographs can be enlarged it is a mistake to think that clearness is not lost in the en-

largement process. Five by seven photographs are in the long run none too large.

The work being done by the breeders of this country is second to none in importance, and every means should be taken to make it more generally known and more interesting to the intelligent public. Striking photographs, unusual ones, will always attract interest and focus attention, as shown by the great use of pictures in commercial advertising. If the methods of business are successful, why should we not copy them?

The plant and animal breeder only travels his path once. He hurries along it. Let the sunlight make some sort of a trail behind him which those who come after can read! The printed word was once the chief method of thought conveyance through the eye, but today we have a new way and many of us apparently do not realize it when it comes to our own special field of work.

Take photographs liberally. Take such as tell the story adequately. Remember you will need series of them. Study the arrangement of your objects. You will be amazed at the way these photographs will increase the romance with which as a scientific man you surround yourself. You will leave behind you a record which will be far more accurate and perhaps quite as valuable as the written notes you make which give only your own interpretation of what your imperfect eyes see and your imperfect memory recalls. The scientific man who must follow you wants your ideas of course, but he wants to see just what you saw and make his own deductions, or perhaps develop some entirely different theory from the one you were working on.

Photographs are a record which anyone can read and subtle differences can be pointed out easily in good photographs that reams of description could never make plain. The JOURNAL OF HEREDITY must depend for its appeal largely upon good photographs to explain the scientific language of its writers, and research men in genetics should study with assiduity this subject of photographs in order that their work, which this JOURNAL is published to help, shall not die still born but that it shall have a chance to attract to it the young workers who are to take it up and carry it on. If the institutions of research cannot afford to equip themselves with adequate means for the recording of the results of their investigators, let them see if they cannot cut down expenses at some other point than the one concerned with the photographic records of their achievements.

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THE "PROTECTIVE COLORATION" THEORY

A Word of Comment Regarding Its Application to Birds as Outlined in a Previous Article in This Journal

T. BARBOUR
Museum of Comparative Zoölogy, Cambridge, Mass.

I HAVE read with interest Mr. Woods's "Random Test in the Theory of Protective Coloration."[1] This simply consists of presenting photographs of four of the very pleasing little habitat groups which have helped in the much needed modernization of the venerable Boston Society of of Natural History. They represent: (1) Piping Plover on sand and rocks: (2) The next of a Night Hawk on the ground: (3) The nest of a Phoebe among dark green rocks near the water: (4) A Whippoorwill with its nest arranged like the nest in the Night Hawk group.

Now the Limicoline and Caprimulgid groups of birds offer many examples of undoubted protective coloration which have been recognized, described, admired, discussed and admitted as useful to the birds by all naturalists both "field" and "closet" since the dawn of ornithology. The groups of Piping Plover, Whippoorwill and Night Hawk afford no "Random test" for they, as they depict true conditions, inevitably illustrate century old examples or protective coloration and this was well known to us all when the groups were installed. The Phoebe group is in a slightly different catagory. We have sought to illustrate the primitive dwelling place of the Phoebe; no easy task now that practically the entire Phoebe population has come to the conclusion that it is easier not to worry about the relationship between dark green rocks and its coloration and has found that the struts and beams under bridges offer most ideal building sites.

The theories of Mr. Thayer, the artist, here so handsomely endorsed, are in reality only in small part essentially optical. To delimit them especially to determine just what is new, needs not perhaps to "involve learned discussions in natural history" but this appraisal does need common sense and knowedge of the exact ecological conditions under which animals live and of the published literature. We remember in regard to the introduction of dazzle painting of ships that naval authorities differed sharply in valueing the protection afforded. Moreover, the protective value of the "bright and often dazzling colors of birds" has not in any way, shape or manner been *proved* by Mr Thayer's "elaborate and magnificent book," although most suggestively discussed, with many novel and valuable possibilities pointed out for future debate and perhaps in time for experimental confirmation.

The foregoing article was submitted to Dr. Woods as a member of the editorial board of the JOURNAL, who contributed the original discussion, and he returned it with the following note.—*Editor.*

New York, May 26, 1921

Mr. Oliver Olson,
JOURNAL OF HEREDITY,
Washington, D. C.
Dear Mr. Olson:

Enclosed is Mr. Barbour's "Word of Comment." I think that his criticism is, to a great extent, justified. I do not consider that this contribution, which I made, towards the subject of protective coloration was more than a very trivial one. Its title, and in places its contents, evidently convey a seeming importance beyond what this scanty and insignificant material could justify. Let us hope that the discussion of Abbott Thayer's interesting, and often provocative theories may be continued, and especially by those who as artists, or naturalists, are as specialists, qualified to do so.

Very truly yours,
FREDERIC ADAMS WOODS

[1] JOURNAL OF HEREDITY, 11, 6, 1920, p. 284–285, figs. 20–32.

DATURA—AN INVITING GENUS FOR THE STUDY OF HEREDITY

W. E. Safford
Bureau of Plant Industry, U. S. Department of Agriculture

THE GENUS Datura belongs to the Solanaceae, a botanical family remarkable for the narcotic properties of many of its members. Perhaps the most celebrated of them all is the mandrake (*Mandragora officinalis*) so frequently mentioned by Shakespeare, which during the Middle Ages was used in amorous incantations and was believed to have magical virtues. According to early herbalists it would shriek aloud when torn from the ground, causing deafness and even death to him who dared gather it. To escape the penalty, a dog was used by the herbalist to wrest it from the ground, the earth having first been carefully removed from about it and the dog tied to the stalk. An early illustration represents the dog writhing in the agonies of death after having accomplished the feat. Other famous narcotics of the Old World Solanaceae are the deadly nightshade (*Atropa belladonna*), henbane (*Hyoscyamus niger*) and the dutra or dhatura (*Datura metel*) of the Hindoos.

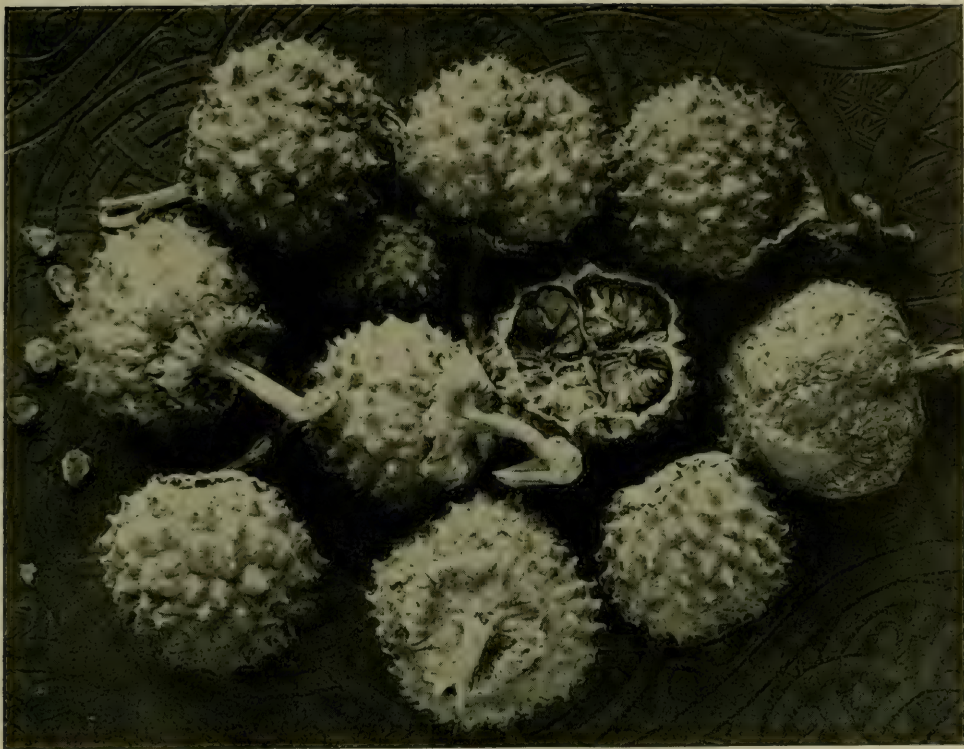
The last named plant derives its specific name from the *jous-methel*, or "metel nut," of the Arabic pharmacopaea, described by Avicenna in the eleventh century together with *nux-myristica*, or nutmeg, and *nux-vomica*, or strychnine. From Dioscorides' translation of Avicenna's description, this so-called nut was recognized by Matthioli and other early botanists as the fruit of a solanaceous plant, which was figured in 1542 by Fuchsius under the name "Stramonia, or Rauchaepffelkraut." In establishing the genus Datura two centuries later, Linnaeus formed a generic name from the East Indian *Dutra*, or *Dhatura*, giving it a Latin form, and explaining it by the following pun: "Daturae, licet originis sit peregrinae, vocabulum persistere valet, cum a latina derivari potest; dantur et *daturae* forte in Indiis posthac semina a lascivis foeminis maritis inertibus."[1]

Fig. 10 is reproduced from a photograph of East Indian metel nuts in the drug collection of the United States National Museum. Fig. 11 is a reduced reproduction of Fuchsius's illustration referred to above. In this figure the corolla is represented as 6-toothed, but normally it is 5-toothed.

SEVERAL VARIETIES DESCRIBED

In establishing the specific name *Datura metel* in the first edition of his Species Plantarum (p. 179. 1753), Linnaeus definitely states: "Habitat in Asia, Africa," and cites his previous description of it in Hortus Cliffortianus (p. 55. 1737). Here it is called *Datura pericarpiis nutantibus globosis*, and is identified with the Arabic metel-nut and the East Indian dhatura, or dutra, "by many called Stramonia." Several distinct formsor varieties are described; among them, α, with a double white corolla (*flore albo pleno*); β, with a simple white corolla (*flore violaceo simplici*); γ, with a double or triple violet corolla (*flore violaceo duplici triplicive*): δ, with a double corolla white within and violet without (*flore pleno, intus albo, foris violaceo*). In the accompanying illustrations (Fig. 12) are shown the typical form of *Datura metel* L. with simple white corolla (No. 1) together with its dried fruits, "*pericarpiis nutantibus globosis*" (No. 2), and its varieties "Flore albo pleno" (No. 3) and "flore pleno, intus albo, foris violaceo" (No. 4), the two last named photographed from plants propagated at Arlington by Mr. H. A. Allard of the Bureau of Plant Industry.

[1] Linnaeus. Hort. Cliffort, 56. 1737.



THE ARABIAN JOUZ-METHEL, OR METEL NUT

Described by Avicemna in the eleventh century (*Datura metel* L.). These are specimens from the drug collection of the U. S. National Museum. Datura is a genus of large, coarse, rank-smelling, poisonous plants of the nightshade family, growing in waste places, with large, showy, funnel-shaped flowers succeeded by globular, prickly, four-celled capsules. All the species, of which the thorn-apple or Jimson weed is the best known, possess narcotic and poisonous properties. (Fig. 10.)

There can be no question as to the identity of Linnaeus's *Datura metel,* and there can be no excuse for calling it *Datura alba* or *Datura fastuosa* (the latter name applied to its forms with double corollas) nor for transferring its perfectly valid name to the American "downy thorn-apple" (*Datura innoxia*) described by Miller in 1768.[2]

Both the white-flowered and the colored varieties of *Datura metel* are used as intoxicants; it would be interesting to determine which is the most efficacious. In 1563 Garcia de Orta, physician in charge of the hospital of Goa, Portuguese India, published an account of the criminal uses of dhatura by servants and highway robbers. Thirty-three years later Huyghen van Linschoten, in the journal of his travels, described its use by the woman of Goa as follows: "They have likewise an hearbe called Deutroa which beareth a seed, whereof bruising out the sap they put it into a cup or other vessel and give it to their husbands, eyther in meate or drinke and presently therewith the man is as though hee were halfe out of his wits and without feeling, or else drunke (doing nothing but) laugh, and sometimes it taketh him sleeping (whereby he lyeth) like a dead man, so that in his presence they may doe what they will and take their pleasure with their friends, and the husband never know it. In which sort he continueth foure and twentie hours long; but if they wash his feete with cold water hee presently reviveth and knoweth nothing thereof but thinketh

[2] For the synonomy of these two species see the author's Synopsis of the Genus Datura, in Journ. Wash. Acad. Sci. 11:—1921.

A SIXTEENTH CENTURY ILLUSTRATION OF DATURA

This is a reduced reproduction of Fuchsius's illustration figured in 1542 under the name "Stramonia," or Rauchaepffelkraut (*Datura metel* L). It was recognized by the botanists of that time as a solanaceous plant, but the genus Datura was established two centuries later by Linnaeus. (Fig. 11.).

VARIETIES OF DATURA METEL L

No. 1 is a typical, white-flowered single form often called D. *alba*, and No. 2 shows specimens of its dried fruit commonly used as a narcotic. No. 3 shows the form having double white corollas, usually called *D. fastuosa;* and No. 4 is the form with a double purple corolla. Both the white flowered and the colored varieties of *Datura metel* are used as intoxicants. (Fig. 12.)

he had slept." . . "This hearbe," he adds, "groweth in all places in abundance, and although it is forbidden to be gathered or once used, never-the-less those that are the principal forbidders of it are such as dayly eat thereof."

Christoval Acosta, in his Tractado de las Drogas y Medicinas de las Indias Orientales (1578) likens the trumpet-shaped flowers of this plant to those of a Convolvulus and its seeds to lentils. "Among the Hindu *enamoradas*," he says, "few are without Datura seeds among their most highly prized treasures." They were ground to a powder and administered in wine or some other medium as a love potion to the object of their affection; and, Acosta adds, "he who partakes of it is deprived of his reason (*queda enagenado*) for a long time laughing, or weeping, or sleeping, with various effects, and often times talking and replying, so that at times he appears to be in his right mind, but really being out of it, and not knowing the person to whom he is speaking, nor remembering what has happened after his alienation has passed. Many mundane ladies are such mistresses and adepts in the use of this seed, that they give it in doses corresponding to as many hours as they wish their poor victim to be unconscious or transported. And truly if I were to tell stories of what I have heard or seen relating to this matter, and the different ways I have seen people act when under the influence of the drug, I would cover many sheets of paper; but as this is not necessary I will refrain. I will only say that I have never seen any one die from its effects; and I have seen some who have gone about for several days perturbed, and this must have been because it had been given to them in too large doses, which if too great will cause death because this seed contains venomous parts, although the Gentiles administer it as a diuretic with pepper and betel leaves and say that it is efficacious; but this I have not seen nor tried, having other medicines more safe for the purpose."[3]

The high esteem with which this plant was regarded by the ancient Chinese is indicated by Li Shi-Chen, in his celebrated work on the Materia Medica of China, *Pen ts'ao kang mu*, published in 1590. According to this author the Chinese name of this plant, *man t'o lo hua* (probably derived from the Sanscrit) is taken from a famous Buddhist sutra, "Fa hua ching," in which it is stated that when Buddha preaches a sermon the heavens bedew the petals of this plant with rain-drops; and according to a more ancient tradition of the Taoists, the name of the plant is that of one of the circumpolar stars, and every envoy sent down from this star to the earth is supposed to carry in his hand one of its flowers; so that one of the Chinese came to call the flower by the name of the star. Li Shi-Chen gives a pretty good description of the plant, which he says has leaves resembling those of an egg-plant, flowers with a white hexagonal corolla, blooming in the eighth month (September) and round prickly fruits; but his description is corrected by a Japanese botanist, Ono Ranzan, who says that the flower is normally pentagonal instead of hexagonal, and this correction is sustained by Siinuma Yokusai, another authority on old Japanese botany, who gives a very good illustration of the flower in question (Fig. 12, No. 1) identifying it with the typical white-flowered form of *Datura metel*, which is known to the Japanese by the name *Chosen-asagao*, or "Korean Morning-glory."[4]

A synopsis of the genus Datura was published by the writer in the Journal of the Washington Academy of Sciences in order to clear up the existing confusion in its treatment by taxonomists and to straighten out conflicting statements as to the origin of some of the

[3] Acosta, Christoval. Tractado de las Drogas y medicinas de las Indias Orientales, p. 88. 1578.

[4] It is interesting to note in this place that *Datura stramonium*, our common Jamestown weed, which many botanists have supposed to be of Asiatic origin is called in Japan *yoshu Chosen-asagao*, *yoshu*, signifying "foreign."

1 2

3 4

VARIETIES OF DATURA STRAMONIUM L.

No. 1 shows the leaves and fruit of the purple flowered form with armed capsules, usually called *D. tatula;* No. 2, leaves and fruit of the green-stemmed, white-flowered form with armed capsules, the typical form of the species; No. 3, purple flowered forms with armed and unarmed capsules; and No. 4, the white-flowered form with unarmed capsules, *Datura inermis* Jacq. These forms are admirably adapted as material for the study of heredity and mutations as they readily lend themselves to experiments in cross-pollination.

In one of the recent press dispatches sent by the leader of the Mount Everest Expedition, there was this description: "By the roadside were most marvelous hedges of daturas, 15 to 20 feet high, and covered with hundreds of enormous white trumpet-shaped blooms, each eight inches in diameter and fully 12 inches in length. At night they seem to gleam with a kind of phosphorescence emitting a strangely sweet scent." (Fig. 13.)

most common species.[5] An account of the ceremonial and medicinal uses of the various species in both the Old and the New World will appear in the forthcoming Annual Report of the Smithsonian Institution.

In recent years certain varieties of the Jamestown weed (*Datura stramonium*) have been used in the study of the phenomena of heredity and mutations. All of the species are admirably adapted for experiments in cross-pollination. The anthers of the flower chosen for the female parent can be removed easily before their dehiscence and the flower covered before the corolla unfolds. Pollen can be obtained with equal facility from the covered or unfolded flower chosen as the male parent and applied to the stigma of the emasculated flower. By this simple method white-flowered and purple forms, and forms with prickly and with smooth capsules can readily be crossed. Results of experiments of this nature made by Miss E. R. Saunders confirmed in a most striking manner the conclusions arrived at by Mendel relating to inheritance.[6]

In the summer of 1916 the writer collected specimens of purple flowered *Datura stramonium* growing at Round Hill, Virginia, some of which bore unarmed as well as prickly pods upon the same plant. A comparison of the former with specimens of the so-called *Datura inermis* showed them to be identical, while the prickley pods were like those of the purple-flowered *Datura tatula* and the white-flowered *Datura stramonium*.

In July 1916, seeds bearing the label "*Datura inermis*," received from F. A. Miller of the Eli Lilly Company, Indianapolis, were planted in the drug garden at Arlington by Dr. Stockberger of the Bureau of Plant Industry. Plants of four distinct forms were the result, all of which were collected and photographed by the writer. The most abundant, with reddish-purple stems, lavender-colored corollas, dark violet anthers, and upright, prickly capsules, was identical in appearance with the form commonly called *Datura tatula*. Next in abundance, occurring in about equal numbers, were white-flowered plants with prickly capsules like the typical *Datura stramonium* and lavender-colored plants with smooth, or unarmed, capsules; and least abundant of all was a form with white flowers and unarmed capsules, identical in all respects with *Datura inermis*. In Figure 13, No. 1 shows armed capsules of the purple-flowered form commonly called *Datura tatula:* No. 2, pods of the typical white-flowered *D. stramonium;* No. 3, armed and unarmed pods of of purple-stemmed, lavender-flowered plants; and No. 4 the green-stemmed, white-flowered form with unarmed capsules usually called *Datura inermis*.

The evidence offered by the relative abundance of the various forms here shown corroborates the results of the experiments of Miss E. R. Saunders already referred to. Of the antagonistic color characters the violet was dominant and the white-flowered form recessive, and of the contrasted capsule forms the prickly one was dominant and the unarmed recessive.[7] Very similar results were presented in March 1917, by Blakeslee and Avery in the form of a living diagram showing the average results of a dihybrid cross between the purple-flowered, purple-stemmed *Datura stramonium tatula armata* (PAr) and the white-flowered, green-stemmed *Datura stramonium inermis* (WIn). In the latter case all the first generation hybrids had purple flowers and prickly pods, while in the second generation there were 9 purple armed, 3 white armed, and 3 purple unarmed, and 1 white unarmed, in perfect conformity with Mendel's law.[8]

[5] Safford, W. E., Synopsis of the Genus Datura. Journ. Wash. Acad. 11: 173-189, 1921.

[6] See Bateson, W., and Saunders, E. R., Experimental Studies in the Physiology of Heredity; in Reports of the Evolution Committee of the Royal Society of London 1:21, 1902.

[7] See Bateson, W., and Saunders, E. R., Experimental Studies in the Physiology of Heredity, in Reports of the Evolution Committee of the Royal Society of London 1:21. 1902.

[8] Blakeslee and Avery, Adzuki Beans and Jimson Weeds, in Journ. Hered. 8:125-131. 1917.

AN AMERICAN SPECIES, DATURA METELOIDES DUNAL

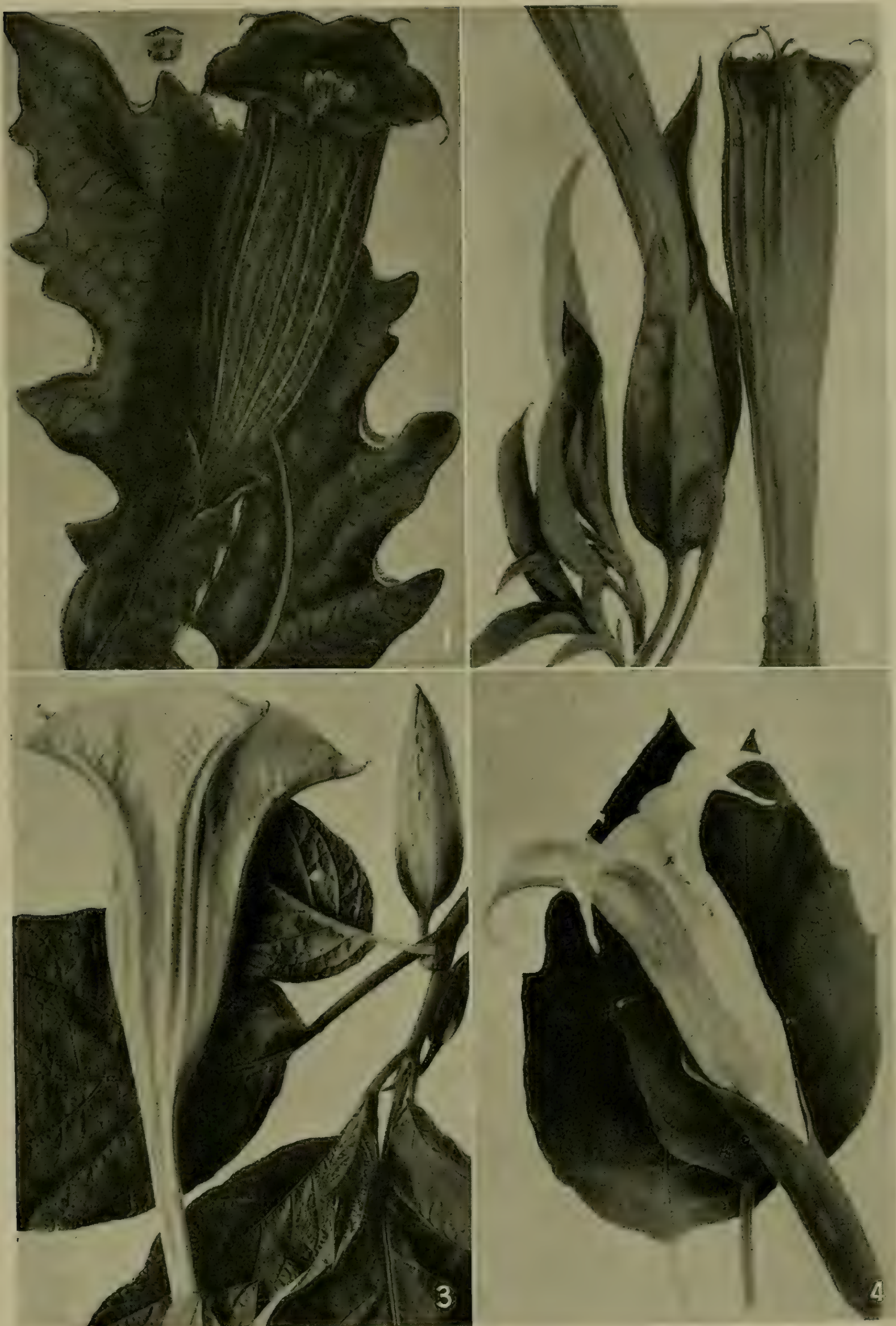
No. 1 shows a flower and fruit of this species, which occurs in two distinct color forms, one with white and the other with pale blue or lilac-colored corollas. No. 2 is a blue tinted flower grown at Arlington, Virginia. No. 3 shows some fruits of the blue and white flowered forms collected at Sacaton, Arizona; and No. 4 some immature fruits of the blue-tinted form grown at Arlington, showing expanded persistent bases of the calyces. (Fig. 14.)

In making their experiments Blakeslee and Avery encountered numerous mutations, chiefly in the relative length of the notes of the stem, and in the form of the leaves and capsules. Among the results of their observations was the discovery that the mutations were sudden, though of rare occurrence, and that they transmitted their characters —chiefly through the female sex— to only a part of their offspring.

That the purple and white-flowered forms of *Datura stramonium* used in these experiments are specifically identical is certain. The statement has been repeatedly made that there is a difference in the relative length of the prickles arming the capsules of the two color forms, but in specimens collected by the writer no such difference could be detected. De Candolle in discussing the possibility of the separate origin of the two color-forms makes the following remarkable suggestion: "Si ces deux formes sont deux espèces, il est très possible que l'une fût de l'ancien et l'autre du nouveau monde, et alors je croirais le *Tatula* américain plutôt que l'autre." (If these two forms are two species, it is very possible that the one was of the Old World, and the other of the New, and then I should believe the Tatula is American rather than the other) After expressing his surprise that Humboldt and Bonpland had found *Datura tatula* to be common in the mountains of Caracas, he still clings to the possibility of its Old World origin, saying: "On indique peu de noms vulgaires pour ces Datura, et le plus souvent ceux usités par les créoles sont dérivés des langues européens et trahissent une importation."[9] ("Only a few native names for Datura are given, and those most frequently used by the creoles are derived from European languages and betray their importation.") As a matter of fact both the white-flowered *Datura stramonium* and the purple-flowered *D. tatula* are found growing spontaneously in many parts of North, Central, and South America. The latter, which as already stated, is the dominant form is naturally most common. De Candolle regretted the absence of vernacular names for them, which he recognized as important in indicating whether they were endemic or imported. Fortunately we have vernacular names for the very species in question. The Aztec name *tlapatl* still survives in Mexico and is applied to both the white-flowered and purple-flowered forms, sometimes modified to the forms *tlapá* or *tapatl*. Professor Pittier records it from Salvador under the form *tapá*. There is no possibility that these names are of European origin, introduced by the creoles. In addition to them there are creole names, it is true, such as the significant "vuelve-te-loco" in Guatemala. That the recessive white-flowered form should be "naturalized . . . probably from Asia" and the dominant purple-flowered form, so closely allied to it as to be indistinguishable except by the color of its stem and flowers, should be "naturalized from tropical America" is unthinkable; and there is no valid reason for questioning Linnaeus, who, in establishing the species *Datura stramonium*, adds to his brief description: "*Habitat in America, nunc vulgaris per Europam.*"

Datura stramonium played an important part in the religious rituals of certain aboriginal tribes of Eastern North America, who used it in the ceremonial called *huskanawing*, in which boys arriving at the age of puberty were initiated into the status of manhood.[10] It takes its common name Jamestown Weed (now modified to "jimson weed") from its effect upon soldiers sent in 1676 to Jamestown to quell the uprising known as Bacon's Rebellion. The behavior of the soldiers while under its influence, as described by Beverley, recalls the intoxicating effects of the Asiatic *Datura metel* mentioned by the writers already cited.[11]

[9] De Candolle, Alphonse. Géographie Botanique, 2:773. 1855.
[10] Beverley, Hist. Virginia book 3:32, 39. 1705.
[11] Beverley, Hist. Virginia book 2:24. 1705. Safford, in Annual Report Smithsonian Institution for 1916:408. 1917.



FLOWERS OF TREE-DATURAS OF SOUTH AMERICA

No. 4 is the *Datura arborea* L. variety with remotely toothed leaves and flowers larger than the type collected in the Peruvian Andes; No. 3, *Datura suaveolens* H. & B. with inflated calyx, toothed at tip, and coherent anthers, photographed from a cultivated specimen; No. 2, *Datura sanguinea* R. & P. with glabrous orange and scarlet flowers and narrow, entire leaves; No. 1, *D. Rosei Safford* with pubescent saffron-colored flowers and sinuate velvety leaves. (Fig. 15.)

Thus far experiments in cross-breeding Daturas have been confined to forms of *Datura stramonium.* Other species of this genus occur in marked color forms. They vary in the armature of their fruits and are equally inviting for study, especially the Asiatic *Datura metel* above described. The latter has still another interesting form-variation: its corollas as already stated, are sometimes simple and sometimes double. Simple and double flowers of the purple-flowered form, usually called *D. fastuosa*, were collected by the writer from a single plant in the garden of Mrs. Augustus Saint Gaudens, at Coconut Grove, Florida. Simple and double flowers are also encountered in other sections of the genus, including the Brugmansias or tree-daturas of South America.

Datura meteloides, an American species used ceremonially by the Mexicans, Zuñis, and California Indians, occurs in two marked color forms, one with white and the other with pale blue or lilac-colored corollas. In Figure 14 these forms are shown together with their characteristic nodding pods subtended by an expansion of the persistent base of the circumscissile calyx. Very closely allied to this species is the "Downy Thorn-Apple" (*Datura innoxia* Miller) already referred to, an American plant often confused with *D. metel* L., but differing from that species in its downy indument and its 10-toothed instead of 5-toothed corolla.[12] Another form closely related to *D. meteloides* and still more closely to *D. innoxia*, is *D. discolor*, also with nodding fruit and a 10-toothed corolla, but easily distinguished from both of its allies by its black seeds. The narcotic plant called *Ololiuhqui* by the Aztecs was undoubtedly a Datura of this section, although it has been erroneously described as a species of Convolvulus, or Ipomoea. Hernandez, in describing it, uses nearly the same expressions as Acosta when he speaks of *Datura metel*, comparing its trumpet-shaped flower to that of a Convolvulus and its seeds to lentils.

All the Daturas thus far described produce an abundance of seeds. Few of the tree-daturas, or Brugmansias of South America, on the other hand, are known to be fertile in cultivation. They therefore present greater difficulties as material for the study of heredity. It is quite possible that in their native habitats they are pollinated by long-billed humming birds, and those that bloom in the evening and are fragrant during the night may like other Solanaceae, attract nocturnal moths allied to the Sphingidae with proboscids long enough to reach the nectar at the base of the filaments. Lagerheim noticed that certain species growing in Ecuador are cross-pollinated by a humming-bird belonging to the genus Docimastes having a bill 12 cm. long. This bird visits the long pendulous blossoms apparently in quest of small insects as well as of nectar. Shorter-billed species rupture the corolla tubes from without. The flowers of the tree-daturas vary greatly in color as well as in the form of the calyx. The latter in some species is spathe-like and pointed, in others notched or toothed at the apex. It would be of great interest to cross-pollinate the white-flowered *Datura arborea* with the recently described red-flowered *D. rubella* which closely resembles it in form; and the orange-flowered *D. aurea* or the delicate pink *D. mollis* with the white-flowered *D. candida.* Crosses might also be made between the Brazilian *D. suaveolens*, which has coherent anthers, a 5-toothed inflated calyx and slender fusiform fruit with other species having distinct anthers, spathe-like acuminate calyces, and spheroid or oval fruits. It would be equally interesting to observe the effects of crossing *Datura sanguinea* or *D. rosei*, species with the fruit enveloped in a persistent husk-like calyx, with other species like *D. pittieri*, in which the calyx is quite deciduous.

Figure 15 shows the flowers of four

[12] Typical specimens of *Datura innoxia* Miller, called by the Aztecs Nacazcul, or Toloatzin, were collected by Dr. Edward Palmer in 1898 in the vicinity of San Luis Potosi, Mexico (No. 677).

FRUITS OF TREE-DATURAS OF SOUTH AMERICA

No. 4, typical form of *D. arborea* L., with entire leaves, and spheroid fruit; No. 3, the *Datura arborea* L. variety with larger flowers and leaves remotely toothed instead of entire; No. 2 D. *pittieri Safford*, a fruit quite devoid of vestiges of the calyx; No. 1, *D. sanguinea* R. & P. a fruit enveloped in persistent husk-like calyx. (Fig. 16.)

contrasted species of the section Brugmansia, or tree daturas: *Datura arborea*, *D. suaveolens*, *D. sanguinea*, and *D. rosei*. Figure 16 shows fruits of plants belonging to the same section: No. 1 of the typical form of *D. arborea*, with entire leaves collected by Mr. O. F. Cook in the Andes of Peru; No. 2, of a second form of the same species with remotely toothed leaves and somewhat larger flowers; No. 3, of *Datura sanguinea* with narrow entire leaves and glabrous red flowers; and No. 4, of *D. rosei* a closely allied species with sinuate or lobed velvet leaves, and pubescent saffron-colored flowers with tomentose peduncles.

Tree daturas are usually propagated by means of cuttings. It is quite possible, however, to obtain seeds of most of them in their natural habitats, and by crossing their progeny developed varieties rivaling the hybrid Cannas, Begonias and other beautiful creations of recent years.

EDUCATION AND THE SIZE OF FAMILIES

Worcester, Mass.

The Editor,
Journal of Heredity,
Washington, D.C.

Dear Sir:

There have been a number of investigations as to the size of families of college graduates, compared to nongraduates, the universal conclusion being that the college graduates do not produce enough children to maintain their numbers. Further figures show that the graduates of women's colleges produce but little more than half as many children as those from coeducational colleges, largely because a smaller proportion of the former marry. These facts are well enough established so that it is not necessary to quote figures, but the interpretation of these figures is a subject that badly needs study.

Some investigators look at the small number of children in the families of the women graduates, and jump to the conclusion that they have located the trouble, but the records of women in the same class of society, who do not attend college, show a similar condition. There may be a fault here—there very likely is—but for the principal causes we must look further.

FAMILIES OF SCIENTIFIC MEN

Cattell, in the Scientific Monthly, Vol. 4, page 248, has given some interesting data on this subject in an article about the families of scientific men. This data is especially valuable as it was collected without any reference to the theory that I am supporting. He shows that while early marriages, in general, produce larger families, in the case of scientific men those who marry between the ages of 25 and 30 have the largest families. He further shows that the educated wife of a scientific man has nearly if not quite as large a family as the uneducated wife.

These two facts have received but little consideration, but are extremely significant. Further investigation should be undertaken in other groups of society along similar lines, such as among the doctors, ministers, laborers, etc. It would also be interesting to see if the same results are to be found among the unsuccessful scientific men, for Cattell only considered the successful ones. Possibly the relationship of early marriage and large families is not one of cause and effect, but is only a common characteristic of the same classes in society, and that if we could postpone the marriage of the feeble minded they would have even larger families. But this does not seem probable. It is more likely that this is confined to certain classes. To which classes is it confined and for what causes?

ECONOMIC REASONS FOR SMALL FAMILIES

Scientific men have a conspicuously small income when young. Given a wife to support, together with a strong interest in science to engage his attention, what is more natural than that the financial needs should tend toward a limitation in the size of the family; and if limitation is well established for a period of years, what is more natural than that it should continue regardless of future conditions. I have no evidence that such is the case, and proof would be difficult to obtain, but the probabilities point to such a conclusion.

Financial needs are a variable, depending upon the standard of living. The problem is then to make the income, the standard of living, and the age of marriage meet at a common point, as early in life as possible. All three variables are difficult to change, but our educational institutions have a great effect on all people.

The standard of living depends largely on the incomes of the parents and friends of the individual, and also on the wife's surroundings. The desired result can be obtained by reducing the standard of living, which means reducing the incomes of the older members of society. A high standard of living is desirable, but one higher than necessary for physical and intellectual health is injurious if it interferes with the production of children of the best inheritance for the coming generation.

The colleges claim that they increase the income of the older persons. That is to say, in addition to cultural benefits, the colleges also give financial benefits, but that these benefits are not seen until late in life. It is evident to all that the colleges decrease the income of young people below the age of 25 or 30 or possibly higher. We therefore have a double charge against the college, based on its own claims. It puts two obstacles in the way of the families of their graduates—a small income when a large one is most needed, and a large one when it can only be an injury eugenically. Some of us question the claim that the colleges increase the incomes of their graduates at any time of life.

The proposition that I wish to make is that the condition most favorable to large families is an income of the sons equal to that of the parents at as early an age as possible. I cannot see how the education of the wife is an important factor. At present this condition is met among those of inferior parents, and therefore of probably inferior inheritance, and among the foreign families where the parents have been kept back by ignorance of our customs. It is farthest from being true among those with the best inheritance, and the colleges are largely responsible for the condition. From the point of view of eugenics, therefore, is not college training one of the greatest menaces to our civilization?

Very truly yours,
A. W. Forbes

CONSPICUOUS VALUE OF PUREBREDS

The value of purebred live stock, say specialists in the United States Department of Agriculture, is most noticeable in those cases in which the capability of the animals is measured most directly. Among farm animals the best illustration can be found in dairy cattle, though careful yearly tests of milk and butterfat production are relatively recent affairs. The enormous differences among dairy cows when given the same opportunity have been brought out clearly in a great number of cases, and these differences are strongly inherited through both the sire and the dam. The average production for purebreds and grades is much above the average of all milk cows, which is about 4,000 pounds of milk and 160 pounds of butterfat annually. —*Weekly News Letter, U. S. Department of Agriculture.*

A RABBIT WITH FIVE LEGS AND SIX FEET

Through the kindness of Mr. B. J. Livermore of Newark Valley, N. Y., I am permitted to report an interesting anomaly belonging to his collection. The rabbit shown in the photograph was captured when not more than three or four weeks old, and sent to Mr. Livermore who prepared its skin. There were several other young rabbits in the litter, all of them normal. There was an extra right hind leg, while the one in the normal position had a bifid foot. In view of the nature of the deformity it is unfortunate that it was not possible to determine its transmissibility. —Dr. F. E. Chidester, Department of Zoology, West Virginia University. (Fig. 17.)

THE DAWN OF EUGENICS

A farmer showed me a calf, and the point of his hopes and ambitions concerning it centered more in its parents than the little, milky-nosed creature itself. He spoke with enthusiasm of its dam's varied virtues and its sire's bovine grandeur of girth and constitution, hoping that the little bull would develop these good points and better his havage in his progeny.

Why do we not love our unborn as well as stockraisers and those who labour at new onions and potatoes? Surely the child is as important as the horse he will ride, or the beef and vegetables he will consume.

Let our hearts grow a little hotter for the boys and girls to be; let them share our dreams with the sheep and the sweet-pea of the future. Let us think upon them oftener, that when they come we can trust them to be wiser than ourselves; that when they have donned their flesh and we have doffed our own, they may look back and know that, despite our limitations, we loved them. The foreglow of such a hope is upon the horizon, but, curiously enough, the religious resent it. Yet eugenics must brighten into a good dawn presently.[1]

No doubt there are some people who believe that all marriages are made in heaven, so that human judgment is excluded, but few people who face this question at all will deny the need of higher standards of responsibility in relation to marriage. Will any deny the right of the child to be born of normal, healthy parents, or the right of young men and women to avoid disease, deformity, or hereditary defects, so that they may look forward to normal, healthy children?

[1] Eden Phillpotts—A Shadow Passes.

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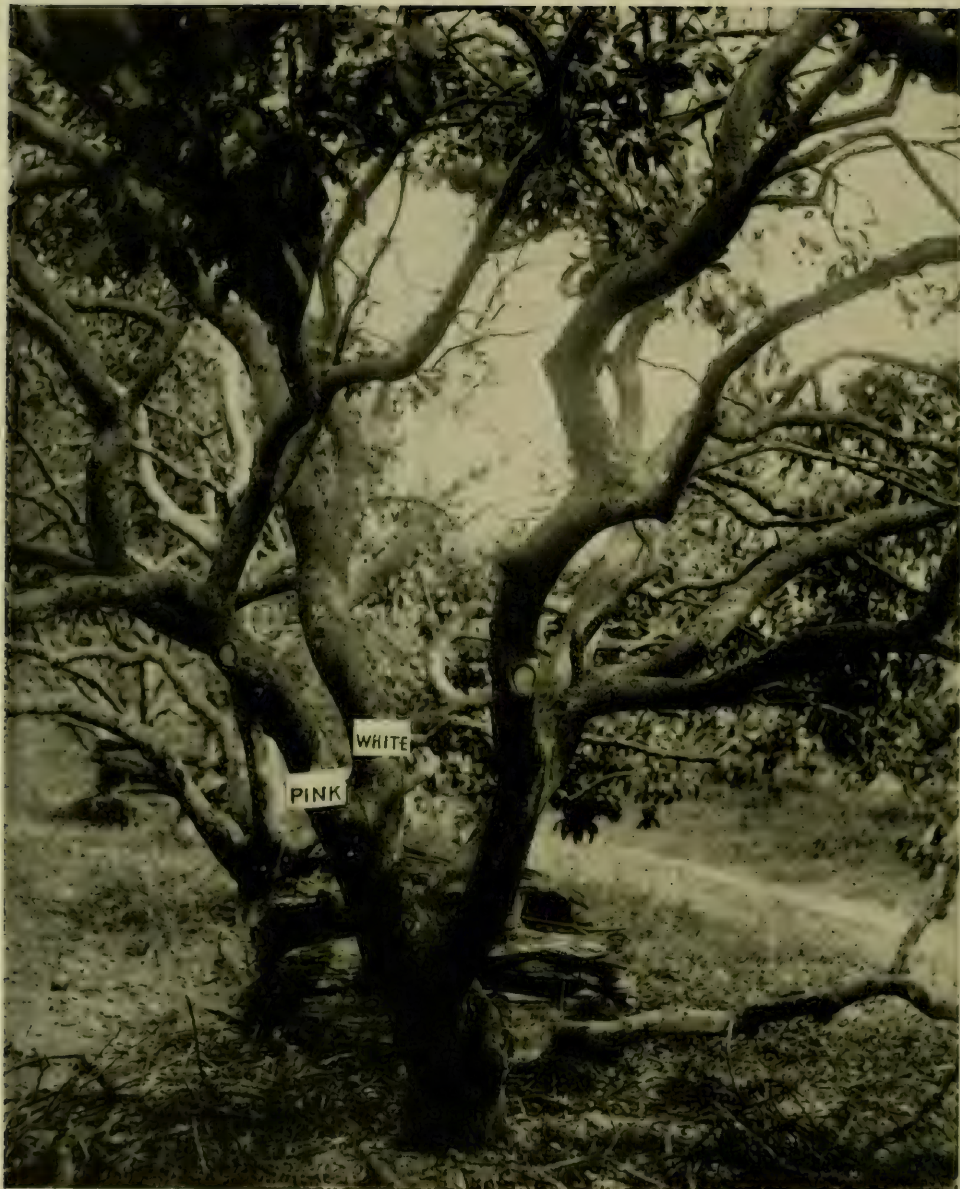


PARENT TREE OF THE FOSTER PINK-FLESH GRAPEFRUIT

This is the original tree from which the Foster pink-fleshed grapefruit was derived as a limb sport. The branch marked "pink" bears the pink-fleshed fruits while the rest of the tree bears Walters grapefruit, the ordinary variety. The tree is growing at Manavista, Florida. Its pink fruits, except for the coloring which is only in the dividing membranes, do not differ in their physical characteristics from the ordinary Walters variety, but they are found to mature earlier. (Frontispiece.)

THE BUD-SPORT ORIGIN OF A NEW PINK-FLESHED GRAPEFRUIT IN FLORIDA

T. Ralph Robinson
Crop Physiology and Breeding Investigations, U. S. Dept. of Agri.

THE occurrence of citrus fruits having pink flesh has been noted from time to time, occasionally under circumstances which have made it impossible to trace the fruit to the parent tree.

Mr. A. D. Shamel has recently called attention to the bud-sport origin of a pink-fleshed strain of Marsh grapefruit in California.[1] In this connection he refers to the origin of the well-known Foster variety (a pink-fleshed grapefruit) which originated as a bud sport of the Walters grapefruit in Florida.

In response to an inquiry from Mr. Shamel for photographs of Foster fruits, the writer, then in Florida, found that there was no authentic record or photograph of the parent tree of this variety. Steps were immediately taken to locate the parent tree and secure photographs. Fortunately, the limb which bears the pink-fleshed fruit was marked at the time of discovery with a letter "p" cut into the bark, so that the tree was finally and with certainty located. It stands in the Atwood Grove at Manavista, Florida.

The main portion of this tree bears Walters grapefruit, one branch only (marked "pink" in the photograph) producing pink-fleshed fruit, but not otherwise differing in its physical respects from the Walters. (See Frontispiece). The variation was first discovered by R. B. Foster of Manatee, Florida, during the season of 1906–07. Mr. Foster was at that time foreman of the Atwood Groves. Mr. E. N. Reasoner of the Royal Palm Nurseries at Oneco, Florida, became interested in this unusual fruit and since 1914 has catalogued and distributed the variety which he named the "Foster" after the discoverer. While usually described as a pink-fleshed fruit, careful examination of the cut fruit reveals the fact that the color lies solely in the membranes separating the pulp vesicles and in the lining of the rind. The pulp itself is not colored but is so transparent that the color of the "rag" shows through the pulp, making it appear pink. The rind, as mentioned by Mr. Shamel, often shows traces of pink color in uneven areas. Though apparently not otherwise differing from the Walters variety, this bud sport, the Foster, seems to mature earlier than the parent variety and it is now being catalogued and recognized as an *early-maturing grapefruit.*

THE PINK MARSH GRAPEFRUIT

It is rather remarkable that another pink-fleshed grapefruit—the Pink Marsh—should have originated in the same section of Florida, springing, as the Foster did, as a bud sport from a well established variety, the Marsh (or Marsh seedless). Not more than five miles south of the Atwood Grove the pink Marsh was discovered in a grove belonging to W. B. Thompson, adjoining the Royal Palm Nurseries, near Oneco, Florida. Mr. S. A. Collins of Oneco, who first discovered this fruit, gave the writer an account of the finding, substantially as follows: In 1913, while looking through the grove to pick some fruit of uniform size and grade to fill a special order, he selected

[1] Shamel, A. D. Origin of a grapefruit variety having pink-fleshed fruits. Journal of Heredity, XI, n. 4, p. 157. Apr. 1920.

ORIGINAL TREE BEARING PINK MARSH GRAPE FRUIT

This tree stands near Oneco, Florida, and is the original one on which the pink Marsh grapefruit was discovered. It is not more than five miles from the grove containing the tree which bears the Foster pink-fleshed fruits. Two branches bearing typical Marsh fruits have been pruned off this tree so that the entire tree now produces only pink-fleshed fruits. (Fig. 1.)

A PINK-FLESHED MARSH GRAPEFRUIT

The Marsh pink grapefruit originated as a bud-sport at Oneco, Florida. In this fruit the color occurs in the pulp itself and not in the inner rind and attached membranes, while in the Foster grapefruits and in the Riverside strain of the pink Marsh, the color is only in the separating membranes and inner rind. (Fig. 2.)

a tree apparently of the Marsh seedless variety. On cutting one of the fruits he found it to be pink-fleshed and seedless. He knew at once that it must be something unusual, as he was already familiar with the other known pink grapefruits, the Tresca and the Foster. (The Tresca, an inferior sort, is generally believed to be a hybrid between the pink shaddock and the true grapefruit.)

On further investigation, Mr. Collins found that the other two branches of the tree (on the north and east) bore typical Marsh grapefruit, white-fleshed and practically seedless. Only the south branch bore the pink-fleshed fruit. Calling the attention of the owner of the grove to this unusual specimen, it was decided that the new fruit was worthy of propagation, and, in order to increase the amount of available budwood of the pink variety, the north and east branches (bearing typical Marsh fruits) were pruned off. The one branch remaining was the

largest of the three, and since then has grown practically erect. (See Fig. 1.) The scars are still plainly visible where the other branches were removed. The tree is budded on rough lemon stock as root sprouts (removed at the time of photographing) clearly show. All of the fruits borne by this tree are pink-fleshed.

A number of old orange trees (109) grafted over to this new variety in 1914 by Mr. Collins, bore the second year (1916) a few fruits showing the pink flesh and other characteristics of the parent tree. The freeze of 1917 destroyed these grafts when in full bloom. Mr. Reasoner, however, has some budded trees of the pink Marsh which were bearing this season, and the fruit was in every way similar to that secured from the parent tree.

In the pink Marsh grapefruit the flesh itself is pink, a character in which it differs from the Foster and from the pink strain of the Marsh described by Mr. Shamel as occurring at Riverside, California. The color of the flesh in midseason (January and February) is a beautiful pink, but later the color fades decidedly, in late March and April being a shade of amber rather than pink. A cross section of this fruit is shown in Fig. 2.[2]

There is considerable evidence in the case of the pink Marsh (as with the Foster) that the mutative influences which result in pigmentation also bring about early maturity of the fruit.

Crosses have been made by the writer between these two pink varieties in the hope of intensifying and making more permanent the color of the flesh while preserving the desirable size, shape, texture and seedless character of the pink Marsh.

[2] A preliminary examination of a preserved specimen by Dr. Lon A. Hawkins indicates that the coloring matter present is probably not anthocyanin, usually lacking in Citrus fruits, though said to occur in blood oranges.

The Genetics of Plant Life

Heredity and Evolution in Plants by C. Stuart Gager, director of the Brooklyn Botanic Garden. Pp. 265, with 113 illus. Philadelphia, P. Blakiston's son and Co., 1920.

This convenient book is made up principally of chapters reprinted from the author's *Fundamentals of Botany*. The book begins in the classical way, with the life history of a fern, goes through experimental evolution, takes up the historical phases, and then deals with the evolution of plants from a broad point of view. The strictly genetic sections seem to be hardly up to date. Many of the illustrations are particularly good. P. P.

The New Psychology

Psychopathology, by Edward J. Kempf, M.D. Pp. 762 with 87 illus., price $9.50. St. Louis, the C. V. Mosby Co., 1920.

In this work, which is intended for the profession rather than for the general reader, Dr. Kempf has put forward a mechanistic explanation of mental processes, which while not perfect ought to be of considerable use. He manifests not only indifference but hostility to the idea that may be an important factor in the causation of mental deviations. Of eugenic interest is his strong condemnation of the American practice of placing the education of youth mainly in the hands of celibates. The volume consists largely of case-histories, with comments by the author, but an extended introduction and conclusion give a clear and well-organized outline of Dr. Kempf's somewhat extreme point of view on the problems of abnormal psychology. P. P.

CAUSES OF SHEDDING IN COTTON

Genetic factors indicated, as well as Structural and Environmental causes

O. F. Cook
Bureau of Plant Industry, U. S. Department of Agriculture

IN VIEW of the recent publication of Professor Lloyd's long-expected contribution,[1] and the interest that is likely to be aroused by so extensive a treatment of the subject, attention may be called to additional facts that may affect some of the conclusions.

Shedding is one of the special terms of cotton culture, referring to a fact of great agricultural importance, that many floral buds and young bolls are blasted and fall off, even when there are no direct injuries by boll weevils or other pests or diseases. Some writers treat shedding itself as a disease, while others consider it a normal habit of the plant to reject superfluous buds or young fruits that could not be brought to maturity. The widely divergent opinions show the need of more information.

Shedding is a consequence of abortion, and the danger of excessive abortion is to be recognized in the breeding of varieties, as well as in the improvement of cultural methods. The diversity and complexity of the environmental factors of shedding are well shown in Lloyd's paper, although the experimental work was limited to a few seasons and to eastern Upland varieties. Shedding of the floral buds, or "squares," is treated, as well as shedding of young bolls.

WHERE PEDICELS LET GO

Two questions may be asked about causes of shedding: why the buds and the young bolls abort, and how they are released from the plant. Any injury to the buds or young bolls, or any external condition that inhibits their development may be a cause of shedding. No doubt the primary causes, those that determine whether abortion is to take place, are genetic and physiological, but the method of shedding has a morphological aspect that needs to be considered, in the interest of a clear understanding of the behavior of different varieties.

The normal method of shedding is by disarticulation, that is, by unjointing of the socket where the base of the pedicel is inserted on the fruiting branch. Lloyd's studies show the lack of a structurally specialized abscission layer, and that shedding may result from merely indeterminate divisions and disintegrations of cells, often limited to one or two layers, but this does not justify the general statement, that "the position of the abscission layer is not predetermined by any anatomical relations, but is an expression of a purely physiological phenomenon." On the contrary, it appears that abscission has a very definite morphological position, occurring always at the same place, in the socket or insertion of the pedicel, which is bordered and bounded by the stipular rim.[2]

Considering that pedicels represent internodes, the sockets are the articulations or nodal points, where unspecialized, embryonic tissues would be expected. The articulation is marked

[1] Lloyd, F. E., "Environmental Changes and their Effect upon Boll-Shedding in Cotton (*Gossypium herbaceum*)." New York Acad. Sci. 29:1–131, 1920. Since the observations relate entirely to American Upland varieties, the name *herbaceum* is not applicable. It belongs to cottons of the Asiatic type, which are not cultivated in the United States. The American Upland cottons are referable to *Gossypium hirsutum*, although some writers place the Texas Big-Boll varieties under *Gossypium mexicanum*.

[2] See Morphology of Cotton Branches, Circular 109, Bureau of Plant Industry, Jan. 4, 1913, p. 13, and Brachysm, A Hereditary Deformity of Cotton and Other Plants, Journ. Agric. Research, 3:394, Feb. 15, 1915. On page 13, line 11, of Lloyd's paper the word "internode" probably should read "pedicel," though the meaning would still be doubtful, since there is no reason to suppose that abscission takes place above the base of the pedicel.

BLASTED BUD OF UPLAND COTTON

Showing abnormal attachment. This is a short fruiting branch with floral bud blasted, but still attached by abnormal decurrent base of pedicel. Slightly enlarged. (Fig. 3.)

on the surface by a minute groove and by absence of oil-glands from a short ring of nodal tissue. Even with the abnormal decurrent pedicel-bases of the "cluster" cottons, abscission still follows the line of the socket, along the stipular rim. (See Figures 3 and 4.) The tearing apart of stipules, as described and figured by Lloyd in a brachytic variety, is itself an evidence of the elongation of the socket. Though brachysm is much less frequent in the Egyptian type of cotton than among Upland varieties, there is a more distinct inequality of the stipules on the fruiting branches, the stipule that is next to the floral but being broader than the other, as though to provide for the enlargement of the socket. (See Figures 5 and 6.) Brachysm has been interpreted as a breaking down or failure of the normal differentiation between the fruiting branch internodes and the pedicel interondes. Not only are many of the joints imperfect where the pedicels are inserted on the internodes, but the leaves and bracts of the abnormal internodes and pedicels show abnormal, intermediate forms, the leaves more bract-like and the bracts more leaf-like than on normal plants.

RELATION TO GROWTH OF PLANTS

With sockets of the normal, circular or transversely elliptical form the pedicels often begin to tear loose at the base while the buds and their enclosing involucres are still fresh and turgid. The buds may wilt after being partially detached, or may fall with scarcely any wilting. That the sockets are too large for the pedicel-bases becomes apparent under a hand-lens, since a gap is formed at once between the separating tissues of the pedicel and the socket, indicating a release of tension. This was noted at San Antonio, Texas, under date of July 21, 1913, and the observation has been repeated on several occasions. In such cases enlargement of the sockets, rather than shrinkage of the pedicels, would seem to be the "mechanical stimulus" of sheddi5g. Lloyd's studies of young bolls showed retarded growth-rates, and led him to the conclusion that "cessation of growth is one of the phenomena of abscission," though without recognizing the morphological relations.

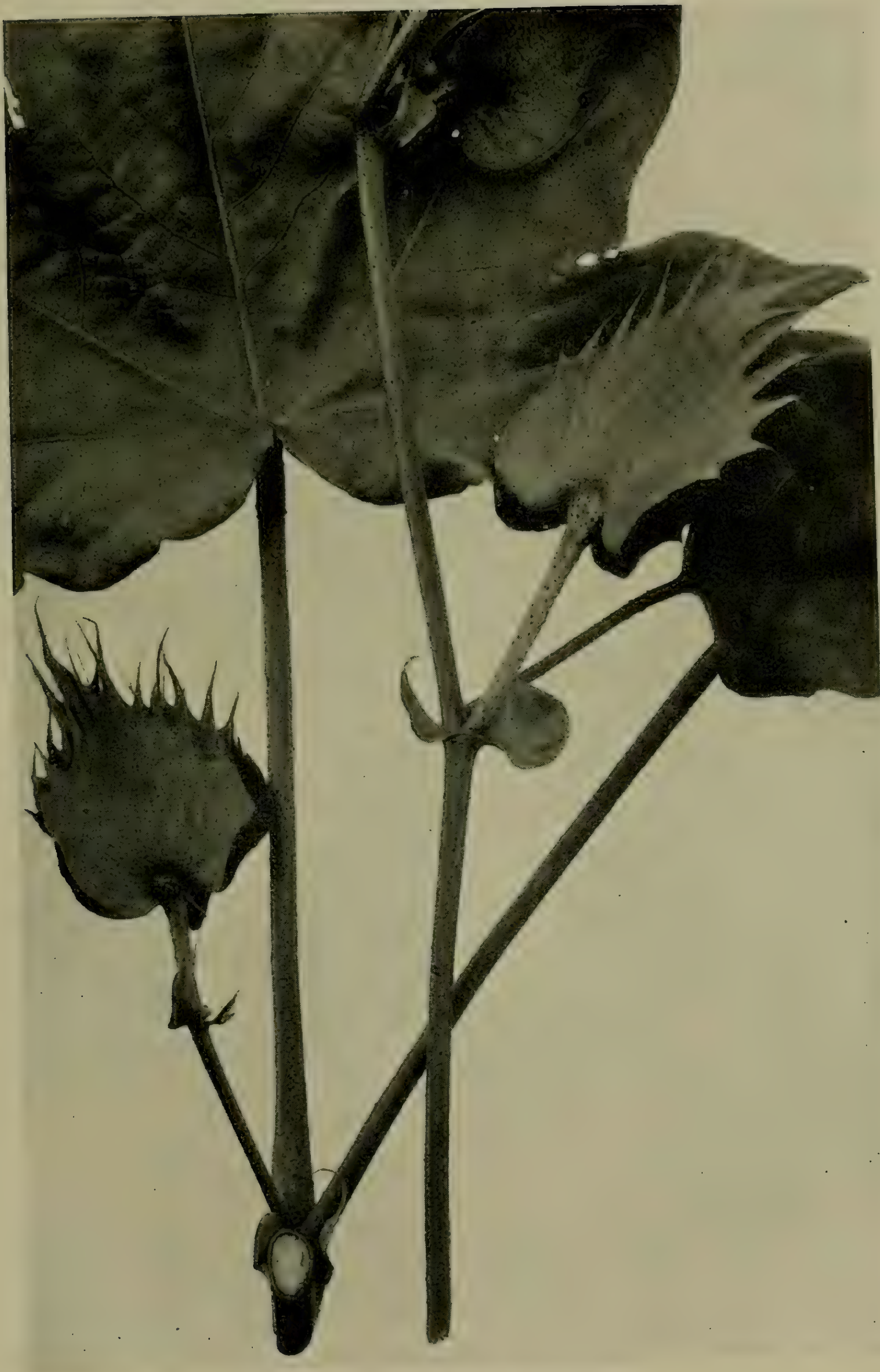
Checking the growth of the floral buds or young bolls while the vegetative framework of the plant is developing rapidly would explain why the sockets may become too large for the pedicels. The growth of the fruiting-branch internodes must continue, of course, in order to support more internodes, buds and

BLASTED BUDS OF UPLAND COTTON

This condition is not a disease but is due to hereditary malformation of pedicels. The buds remain attached to the plant, a condition which is sometimes mistaken for a disease. Instead of shedding promptly and leaving a small rounded socket, like that shown in Figure 3, these abnormal pedicels run down upon the joints of the fruiting branches so that normal shedding does not take place. (Fig. 4.)

ABNORMAL VARIATION OF EGYPTIAN COTTON

Short-jointed, but with normally formed pedicel and small, rounded scar left by a bud which had been shed, to contrast with elongated sockets and failure of normal shedding in Upland "cluster" varieties. Note that the stipules have fallen from the bases of the two lower leaves, but are present on the others, and of unequal size. The second involucre is imperfect, consisting of a single bract, with the bud aborted, which frequently occurs in abnormal variations. Photograph natural size. (Fig. 5.)



NORMAL EGYPTIAN COTTON

Two joints of a normal fruiting branch of Egyptian cotton showing involucre, pedicel and attachment of floral bud, with unequal stipules connected by a stipular rim, enclosing the socket. A short section of the main stalk is shown, with equal stipules and a short axillary branch bearing a single floral bud; subtended by an abortive leaf, with only the stipules developed. The lower joint of the normal fruiting branch, cut near the middle, is more than twice as long as the second joint. Natural size. (Fig. 6.)

bolls, further out on the branch. Shedding of buds is much less frequent with Egyptian cotton than with Upland varieties, but in extreme cases even the young fruiting branches of Egyptian cotton may abort, if the plants are forced into rank growth. That an over-luxuriant condition of the plants may be responsible for shedding was indicated several years ago in a paper that Lloyd seems to have overlooked.[3]

GENETIC DIFFERENCES IN SHEDDING

These facts may be recognized without prejudice to other causes of shedding that Lloyd and earlier writers have advanced, including mechanical injury, pests, diseases, drought, rain, high-temperatures, and "root-asphyxiation," by water-logging of the soil in wet weather or in irrigated regions. Lloyd finds that shedding from mechanical injury is more prompt and regular than from weevil attack. Injured buds fell off most frequently on the second day, while weevil-infested buds had a maximum of shedding on the eighth day. Lloyd advances a theory of "competition between bolls for water" to account for excessive shedding in brachytic varieties, but a genetic factor is plainly indicated in plants that abort all of their buds, while their neighbors mature good crops. Egyptian cotton may retain nearly all of its buds and young bolls while Upland varieties in adjacent rows are shedding nearly all of their buds. Sterile hybrids and sports, including the so-called "bull-stalks" of Sea Island cotton, as well as unacclimatized or abnormally overgrown plants, may produce small flower-buds in great numbers, but shed all of them at an early stage, or a few bolls may be set late in the season on secondary stalks after complete abortion on the primary stalk.

In addition to determining the periods and rates of shedding of squares and young bolls under different conditions, Lloyd finds that "abscission is inhibited during anthesis," meaning that open blossoms do not shed, and that rain destroys pollen and prevents fertilization. To this may be added that in cool, moist weather the anthers sometimes fail to open, so that no pollen is available. Complete failure to set any bolls was observed in 1905 in an experimental planting of cotton in the Senahu district of Eastern Guatemala at an altitude of 2,600 feet, under conditions of continuously high humidity, with moderate, equable temperatures. Although the plants grew to normal size and produced many flowers, the anthers remained closed and the stigmas received no pollen.

[3] See "The Abortion of Fruiting Branches in Cotton," U. S. Dept. of Agriculture, Bureau Plant Industry Circ. 118, March 22, 1913.

The Struggle of Races

THE RISING TIDE OF COLOR, by Lothrop Stoddard, A. M., Ph. D., with an introduction by Madison Grant. Pp. 320, with 3 maps. New York, Charles Scriber's sons, 1920.

In a vivid journalistic style, Dr. Stoddard has written an account of world politics that deserves and will probably get wide reading. He pictures the present world-wide dominion of the white race, which controls nine-tenths of the globe, though it comprises only a third of the inhabitants. Ready to shake off the yoke are three colored worlds. The yellow world of Western Asia is the greatest immediate menace, he believes, and he thinks that the whites should respect its position and gradually withdraw from that part of Asia. The brown world, made up principally of Islam and the Hindus, also seems to him to be due for independence, in the not distant future. In the black world of Africa, and the red world peopled by the autochtones of the Americas, he sees little hope for progress, and concludes that the whites must control these two groups, if only to keep the yellows or browns from conquering them and turning them against the whites. The conclusion of the book, is a plea for eugenics and an understanding of the biological principles underlying the organization of society. P. P.

DEMOCRACY AND THE HUMAN EQUATION

A Review of Alleyne Ireland's New Book[1]

FREDERICK ADAMS WOODS

TWO years or more ago, the JOURNAL OF HEREDITY contained some stirring communications of a provocative sort, and in a field out-side its customary limits. These were brought to press through an article entitled "Democracy and the Accepted Facts of Heredity" by Alleyne Ireland published in December 1918.

The main issue in this debate was whether the theory of extreme democracy, so much exploited since the outbreak of the Great War, could find justification in the work of modern students of biology. Mr. Ireland contended that if the biologists are right in denying the inheritance of traits accumulated through slow action of the environment, and if the students of human heredity are right in claiming the preponderating importance of germ-plasm, then the theory of democracy had some ugly facts to face.

This point of view has scarcely been recognized by any writers on the theory of government. The biologists have gone steadily along, in the last twenty years, since the rediscovery of Mendel's Laws, acquiring more and more proof of the clean-cut control of the chromosomes. The psychologists have piled up convincing evidence of mental and moral heredity, and have found in their mental-age tests (army, mental-tests, etc) undeniable evidence of the fundamental inequalities in human beings, and yet, those who should profit by this work, or at least discuss its significance, have apparently been ignorant of its existence.

Mr. Ireland is a specialist in Government. He has spent his life investigating and studying systems of government in various parts of the world. He has been a correspondent of The London Times, in the Far East; and has published several weighty books on colonial government, including "The Province of Burma," "The Far Eastern Tropics," and "Colonial Administration." He was at one time on the Editorial staff of the New York World, has lived much in America as well as in England, his native land, and so is, at least by nurture fitted for the comparative point of view.

Whether he is right or wrong in this brilliant, and perhaps hypercritical book on present day tendencies in the United States, it is certainly noteworthy that a man of this sort should show an interest in the technical aspects of heredity, and seek to apply them in his own domain.

The controversy held in the JOURNAL OF HEREDITY has now blossomed forth as a book, in which two chapters are devoted to biological relationships, and this section of the work is likely to be of chief interest to the majority of our readers.

Here the author does not follow the usual method of sociologists and political writers, and merely discuss in terms of vague statements and unsupported generalizations (deductive method which ought to be considered out-of-date) but actually appeals to the results of researches.

Almost all of these are now summarized in Popenoe and Johnson's "Applied Eugenics" and Mr. Ireland has made an eager incursion into this modern storehouse. He refers especially to Galton's "Oxford and Cambridge Graduates," Wood's "Heredity and the Hall of Fame" and "Heredity in Royalty," Thorndike's "Twins in New York City." Pearsons, Barring-

[1] Democracy and the Human Equation, by Alleyne Ireland, F. R. G. S., pp. 251. New York, E. P. Dutton & Co. 1921.

ton, Elderton and Heron of Environment, Defective Physique, Eyesight, etc. He quotes from Wood's "Laws of Diminishing Environmental Influence" to show that only in the lower forms of animal life, is much to be expected from environmental pressure.

In taking up the other side of the question and giving consideration to the advocates of environment Mr. Ireland does not quote the work of any recent investigator except that of Mr. C. L. Redfield. This is for the very good reason that, broadly speaking, there are not any others to quote. Larnark (1744-1829) was a great environmentalist and he quotes him. Herbert Spencer was a great environmentalist. He might have quoted him. Odin so much advertised by the late Lester Ward might also have been discussed, though Odin had no method of weighing heredity against environment.

The point of interest is merely this, that the preponderating force of heredity (germ-plasm control) has so slowly and generally become accepted as not to be realized among biologists, until some non-biological specialist enters the field and says: here, what does all this mean to our theories of political control?

IMPORTANCE OF LEADERSHIP

Men are far from equal in natural ability and capacity for achievement. The amount of variation is not known, though some facts suggest that it is probably very great, at least in the higher races. The doctrine of heredity ties up naturally with the more aristocratic belief in the importance of the upper classes and of exceptionally great leaders who, as many investigators have proved, do actually arise in the upper classes in far greater proportion.

As to the importance of greatness in the individual the author says p. 128: "The question resolves itself actually into the choice between a qualitative and a quantitative theory of causation in human achievement. To whatever phase of human development we turn, history fails to furnish a single instance in which an accomplished step can be referred, ultimately, to any cause other than the quality of greatness in the individual. It is this quality which has given the world all that has ennobled man's character, elevated his culture, and extended his mastery over the material elements of life. It is to the genius of a few hundred individuals among the thousands of millions who have lived that we owe all the inspiration of religion, of philosophy, of music, of art, of literature; all the benefactions of science, of discovery, of invention."

While this statement is doubtless, in a way, true, it will seem to many to be an over-statement of the case. It is true that most movements if traced to their source may be referred ultimately to the inspiration and energy of some one genius, or group of great souls, but the subsequent development appear to a great extent to depend on the qualities of the followers, their numerical total, and the opportunities of the epoch.

For instance, one of the greatest of events in the world's history took place when one half of the world discovered the other half, and explo-ed and conquered it. There are a few great names that stand out heroically in the vast records of exploration. Perhaps the figure of Columbus is over-enlarged. It is true, that at the source we find our single and isolated initiator, Henry the Navigator, Prince of Portugal. But how small are most of the individuals compared with the vast importance of their united work.

The same may be said of the upbuilding of the United States.

Indeed the history of pure science shows, not only the greatness of the great pioneers, but that something more than they are necessary. Roger Bacon was a great innovator, but here, things stopped. In the realm of invention, there is probably even more increment, than in pure science, from the many minds who each contribute their mite.

It is not that the reviewer is unwilling to accept the "great-man theory" of history, but he realizes that there are two sides to this question. Researches which some day will enable us to weight these important historical matters have as yet scarcely been more than started.

THE LONG ARM OF GOVERNMENT

The greater portion of Mr. Ireland's book is concerned with the technical aspects of government. He suggests and develops some interesting points of view. He pokes fun at the "rapsodists" as he calls them,—Fourth of July orators, in Congress and out, with their absurdly untrue phrases, about "liberty," "equality," and "natural rights."

If the State must continuously be referred to as a "Ship of State" then it needs a self reliant Captain and a trained crew. On the ship of commerce the Captain does not drift aimlessly towards an indefinite port or take a vote of his crew, during the oncoming storm, as to the management of the ship.

Governments, today, are much more concerned than formerly in everything touching our daily routine, and therefore there is all the more need for expert knowledge. How true this is, the author has picturesquely brought out in the following paragraph, p. 95.

"What is the scope of Government today? I get up in the morning and go into my bathroom: the Department of Justice has been much interested in the Bath Tub Trust. I turn on the water: the Bureau of Public Franchises and the Bureau of Bacteriology rise before me. I grasp my tablet of soap: it is made in Chicago by the Beef Trust, the Department of Justice has to know whether it is the product of an agreement in restraint of trade, and whether the manufacturer secured a rebate from the railroad which transported it. I dry my self with a cotton towel: The Department of Agriculture has helped to afford me this convenience by furnishing the cotton-growers with a report of the bool-weevil. I step out onto my bath mat: it is an important product—was the consular invoice correct, was the full amount of duty paid on it by the New York customs broker? Presently I find myself in the kitchen, and I light my gas stove—the gas is the concern of the Government I put a lamb chop on the broiler, and as it cooks I speculate as to whether the purple stamp of the Government meat-inspector contains any poison. Presently I take a street-car to my place of business: the street-car itself, the power by which it is propelled, the track along which it runs, the stopping-places along the route, are all affected by Government regulations. I enter my office building: the structure is the concern of the Government, on account of the fire laws; the business I do in it is the concern of the Government in a dozen particulars dealt with by the Income Tax Law, The Interstate Commerce Law, the Sherman Act, the Pure Food Law, and so on. Whilst I am reading my mail the telephone bell rings—the telephone is the concern of the Government—some one tells me that my child—the child is the concern of the Government—at the public school—the school is the concern of the Government—has got the diphtheria—the diphtheria is the concern of the Government—I hasten off to pick up my physician—the physician is the concern of the Government—we go to the school in his automobile—the automobile is the concern of the Government—later on I pay him with a National Bank bill—the National Bank is the concern of the Government; and all this is no more than a sketchy outline of what Government is concerned with today."

Another novel point of view is Mr. Ireland's extended analysis between Representative Government and Delegated Government, but space does not permit its discussion here.

The whole tenor of Mr. Ireland's book is a calling out for better government,—a rule of the best, a recognition of the truths of human nature,

and a scienc of government comparable to the sciences of nature that have already done so much for man's advance. Probably the chief criticism that will be brought against this book will be from those who do not believe that present democratic governments are quite as bad as Mr. Ireland paints them. Perhaps they are not, but at least they might be better. And they will become better if they face the facts of science and if those who control them make every possible use of all the humanistic sciences that are making so much progress at the present time. For this reason, "Democracy and the Human Equation" is a distinct contribution towards a better state of things, towards that eugenic ideal, when the best shall survive, and the best shall govern.

AVERAGE HEIGHTS AND WEIGHTS OF CHILDREN UNDER SIX YEARS OF AGE

During Children's Year, the second year of the participation of the United States in the World War, the Childen's Bureau conducted a series of campaigns designed to focus public attention upon the welfare of children. Among these campaigns was the "weighing and measuring test." During the period devoted to this test great numbers of children for the most part under 6 years of age—in all parts of the United States, were weighed and measured. Record blanks were furnished by the bureau, and when the children were brought for examination entries were made of height, weight, age, sex, and race, besides particulars of country of birth of father and mother, and physical condition of the child.

As a result of this campaign the bureau received over 2,000,000 records, and was thus in possession of a larger mass of anthropometric material relating to children of these ages than was ever before available. Consultations were held with anthropologists, statisticians, and pediatrists, and plans of tabulation were prepared in accordance with recommendations made by the authorities consulted.

A careful selection was made of approximately one-twelfth of the cards which had been received. The basis of selection was fourfold: (1) The record card must have been signed by a physician; (2) no serious defects should have been noted; (3) the child must have been weighed and measured without clothing; as verified by the physician signing the card; and (4) all essential items must have been answered.

On the basis of these selected records, tables have been made showing average weights and heights for children of different ages and average weights for children of different heights. They are based upon measurements of 167,024 white children.

The children included in the tabulation were 70 per cent of native parentage; 6 per cent with one parent native and one foreign born; 4 per cent of British and Irish parentage; and the remainder of Scandinavian, Italian, and other racial stocks. They represent children from every part of the country. The averages for white children of native parentage agree very closely with these averages for all white children.

The table shows average heights and weights of boys and girls from birth to 72 months of age.

These averages represent, so far as the original material permits, averages based upon children without defects or diseases.

TABLE I.—*Height and Weight of White Children From Birth to 6 Years of Age.*[1]

Age	White boys		White girls	
	Height (inches)	Weight (pounds)[2]	Height (inches)	Weight (pounds)[2]
Under 1 month	21⅛	9⅛	20⅞	8⅝
1 month, under 2	22½	10⅞	21⅞	10⅛
2 months, under 3	23⅝	12⅝	23⅛	11¾
3 months, under 4	24½	14⅛	24	13
4 months, under 5	25⅜	15⅜	24⅞	14¼
5 months, under 6	26⅛	16¼	25½	15⅜
6 months, under 7	26¾	17½	26⅛	16¼
7 months, under 8	27¼	18¼	26¾	17⅛
8 months, under 9	27¾	19	27¼	17¾
9 months, under 10	28¼	19⅝	27⅝	18½
10 months, under 11	28⅝	20¼	28⅛	19
11 months, under 12	29	20¾	28½	19½
12 months, under 13	29½	21⅜	28⅞	20
13 months, under 14	29⅞	21⅞	29¼	20½
14 months, under 15	30¼	22¼	29¾	21
15 months, under 16	30⅝	22¾	30⅛	21⅜
16 months, under 17	31	23¼	30½	21⅞
17 months, under 18	31⅜	23¾	30⅞	22⅜
18 months, under 19	31¾	24⅛	31¼	22¾
19 months, under 20	32⅛	24⅝	31⅝	23¼
20 months, under 21	32½	25	31⅞	23⅝
21 months, under 22	32¾	25½	32¼	24⅛
22 months, under 23	33	25⅞	32½	24½
23 months, under 24	33⅜	26¼	32¾	24¾
24 months, under 25	33⅝	26⅝	33⅛	25⅛
25 months, under 26	33⅞	27	33⅜	25½
26 months, under 27	34⅛	27¼	33⅝	25⅞
27 months, under 28	34⅜	27⅝	34	26¼
28 months, under 29	34¾	28	34¼	26¾
29 months, under 30	35	28½	34½	27⅛
30 months, under 31	35¼	28⅞	34⅞	27½
31 months, under 32	35½	29¼	35⅛	27⅞
32 months, under 33	35¾	29½	35⅜	28¼
33 months, under 34	36	29⅞	35⅝	28½
34 months, under 35	36¼	30⅛	35¾	28⅞
35 months, under 36	36½	30½	36	29¼
36 months, under 37	36⅝	30¾	36¼	29½
37 months, under 38	36⅞	31	36½	29⅞
38 months, under 39	37⅛	31⅜	36¾	30⅛
39 months, under 40	37⅜	31¾	37	30½
40 months, under 41	37⅝	32	37¼	30⅞
41 months, under 42	37⅞	32⅜	37½	31⅛
42 months, under 43	38⅛	32¾	37¾	31½
43 months, under 44	38¼	33⅛	38	31¾
44 months, under 45	38½	33½	38⅛	32⅛
45 months, under 46	38¾	33¾	38⅜	32⅜
46 months, under 47	39	34	38½	32⅝
47 months, under 48	39⅛	34¼	38¾	32⅞
48 months, under 49	39¼	34½	38⅞	33⅛
49 months, under 50	39½	34¾	39⅛	33½
50 months, under 51	39⅝	35	39¼	33¾
51 months, under 52	39⅞	35¼	39½	34
52 months, under 53	40	35½	39¾	34⅜
53 months, under 54	40¼	35⅞	40	34⅝
54 months, under 55	40½	36⅛	40¼	35
55 months, under 56	40⅝	36½	40⅜	35⅜
56 months, under 57	40⅞	36¾	40⅝	35⅝
57 months, under 58	41⅛	37⅛	40⅞	36
58 months, under 59	41¼	37½	41	36¼
59 months, under 60	41½	37¾	41¼	36½
60 months, under 61	41⅝	38⅛	41⅜	36⅞
61 months, under 62	41¾	38⅜	41⅝	37⅛
62 months, under 63	42	38⅝	41¾	37⅜
63 months, under 64	42⅛	39	41⅞	37¾
64 months, under 65	42⅜	39¼	42⅛	38
65 months, under 66	42½	39½	42¼	38¼
66 months, under 67	42¾	39⅞	42⅜	38⅝
67 months, under 68	43	40¼	42⅝	39
68 months, under 69	43⅛	40⅝	42⅞	39⅜
69 months, under 70	43⅜	40¾	43⅛	39¾
70 months, under 71	43½	41¼	43½	40⅜
71 months, under 72	43⅞	41⅝	43⅝	40½

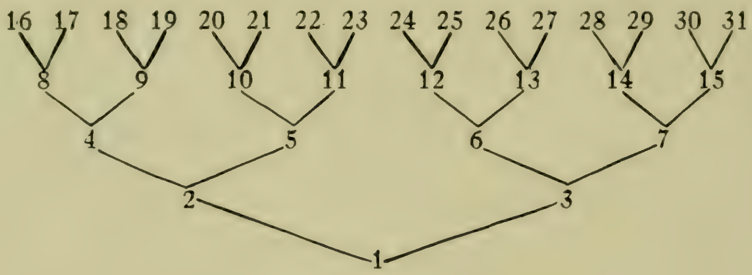
[1] These figures are based upon measurements of 167,024 white boys and girls for whom no serious defects were reported. The averages as calculated have been smoothed and corrected to allow for the inclusion in the basic figures of children with adenoids, diseased or enlarged tonsils or carious teeth, and they represent, therefore, so far as the material permits, average heights and weights of children without defects.

[2] Weights do not include clothing.

A SIMPLE SYSTEM OF DESIGNATING RELATIONSHIPS

Alexander Graham Bell

In dealing with the ancestry and offspring of the multi-nippled flock of sheep which I have been experimenting with for many years it has been found advisable to use contractions of various kinds, among the most valuable of which have been the numbers used to designate relationships. These numbers we call the ancestral numbers and they possess many curious properties which facilitate the investigation of questions concerning heredity. The following arrangement illustrates the scheme:



No. 1 represents the *propositus*, the individual whose ancestry we are considering.

Nos. 2 and 3 are the "First-parents" (father and mother).

Nos. 4, 5, 6, and 7 are the "Second-parents" (grandparents).

Nos. 8, 9, 10, 11, 12, 13 14, and 15 are the "Third-parents" (great-grandparents).

The "Fourth-parents" would be numbered from 16 to 31; the "Fifth-parents" from 32 to 63; the "Sixth-parents" from 64 to 127 etc. The numbering could be continued indefinitely to include higher generations.

Even numbers represent males, and odd numbers females, among the ancestors, and the ancestral number of a wife is always one more than the ancestral number of her husband. Furthermore, by doubling the ancestral number of any individual, we get the ancestral number of his or her father, and by adding one we get the mother's number. (The father of 15 is 30, the mother of 15 is 31 etc.) Conversely, by dividing the ancestral number of any individual by 2 we get the ancestral number of the child. (The child of the man 30 is 15, a female. The child of the woman 31 is 15 a female.)

One can tell at a glance which ancestral numbers represent the fathers and mothers of females because they are divided by 2 into uneven numbers, while the ancestral numbers of the fathers and mothers of males divide by 2 into the even numbers which always designate males.

The ancestral number 2, represents the father of the *propositus*, the individual whose ancestry we are considering; but it does more than this, for it seems to represent the abstract relationship indicated by the word "father." If, for example, you multiply the number of any individual by 2, you get the father's ancestral number. Thus:

The father of 2 is 4
The father of 3 is 6
The father of 4 is 8
etc.

No. 2 is the father and No. 3 is the mother. Multiply by 2 and you get the father of any individual; but multiply by 3 and you don't get the mother.

To make the ancestral numbers, in all cases, indicate abstract relationship, consider them as powers of 2, *plus* whatever figure is required to complete the ancestral number.

2.	The father	$=2+0$
3.	The mother	$=2+1$
4.	The father's father	$=4+0$
5.	The father's mother	$=4+1$
6.	The mother's father	$=4+2$
7.	The mother's mother	$=4+3$
8.	The father's father's father	$=8+0$
15.	The mother's mother's mother	$=8+7$

etc.

"Mother" $=2+1$

The mother of $2=2\times2+1=5$
The mother of $3=3\times2+1=7$
The mother of $9=9\times2+1=19$

"Maternal Grandfather" $=4+2$

Maternal grandfather of $2=2\times4+2=10$
Maternal grandfather of $3=3\times4+2=14$
Maternal grandfather of $9=9\times4+2=38$

"Paternal grandmother" $=4+1$

Paternal grandmother of $2=2\times4+1=9$
Paternal grandmother of $7=7\times4+1=29$
Paternal grandmother of $15=15\times4+1=61$

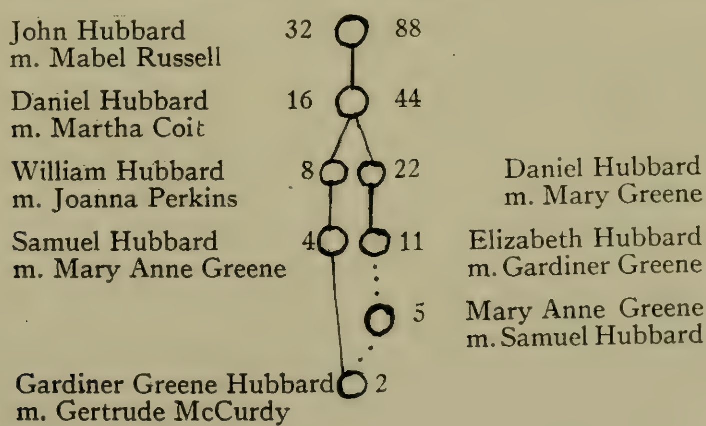
These tables indicate some of the curious properties that these ancestral numbers possess. By their use we can indicate complicated relationships in an exact manner, and in a way that cannot be expressed in words.

The system of ancestral numbers is admirably adapted for the discovery and study of consanguineous marriages as was found in my study of the ancestry of Mabel Gardiner Hubbard. (Beinn Bhreagh Recorder, Vol. XV.) It was observed that the same individual may have two or more ancestral numbers. For example: John Hubbard, who married Mabel Russel, appears as No. 32 and also as No. 88, indicating that two of his descendants have married one another. This means that Mabel Gardiner Hubbard traces up to John Hubbard by two lines.

In order tc discover the consanguineous marriage, divide both ancestral numbers by 2 until you reach the husband and wife:—

32	88
16	44
8	22
4	11
	5

Nos. 4 and 5 are husband and wife, and they are both descended from John Hubbard, (who married Mabel Russell), and the connecting numbers indicate the two threads of ancestry and the sex of the intervening ancestors. By hunting up the numbers in the list of ancestors given in the Recorder, Vol. XV, pp. 3–36, we can ascertain the names of the individuals concerned. Nos. 32 and 88 represent the same individual, John Hubbard. Represent him by a single circle:—



Nos. 16 and 44 also represent a single individual, Daniel Hubbard, who married Martha Coit, represented by a single circle. Nos. 8 and 22 are two distinct individuals, represented by two distinct circles.

Nos. 4 and 11 are two distinct individuals, represented by two distinct circles etc., etc.

The circles are connected by a thick straight line when the descent is through a male (even number) and by a dotted line where it is through a female (odd number).

We learn from this that the husband and wife (Nos. 4 and 5) were blood relatives. Their nearest common ancestor was Daniel Hubbard (who married Martha Coit). He was a second parent of No. 4, and a third parent of No. 5, so that Nos. 4 and 5 were second and third kin through Daniel Hubbard.

Through the system of ancestra numbers, consanguineous marriages are readily discovered, and the exact relationship of the contracting parties determined: It is purely an arithmetical process.

MALE AND FEMALE FARMERS IN THE UNITED STATES

The number of farms in the United States on January 1, 1920, according to the Fourteenth Census, was 6,448,366. Of this number 6,186,813, or 95.5 per cent, were operated by male farmers and 261,553, or 4.1 per cent, by female farmers. There are no comparative figures for earlier years, since the census of 1920 was the first to obtain information separately for male and female farm operators.

The percentage of farms operated by women in the various states ranged from 1.9 in Nebraska to 7.2 in Rhode Island. In seven states the proportion of farms operated by women was 6 per cent or greater. These states were Rhode Island, with 7.2 percent; Mississippi, with 7.0 per cent; New Hampshire, with 7.0 per cent; Connecticut, with 6.9 per cent Alabama, with 6.4 per cent; Massachusetts, with 6.2 per cent; and South Carolina, with 6 per cent.

Of the 6,186,813 male farmers, 3,737,326 were owners, 67,762 were managers, and 2,381,725 were tenants. The 261,553 female farm operators were distributed as follows: 187,769 owners, 763 managers, and 73,021 tenants. In 1920, 60.4 per cent of all male farmers were owners, 1.1 per cent were tenants, while 71.8 per cent of all female farmers were owners, 0.3 per cent were managers, and 27.9 per cent were tenants.

The total land area in farms on January 1, 1920, was 955,676,545 acres. Male farmers operated 929,878,145 acres, or 97.3 per cent, of the total farm acreage, while female farmers operated 25,790,400 acres, or 2.7 per cent.

The following is a tabular classification of male and female farmers in the United States.

	Number	Per cent of total
All farm operators......	6,448,366	100.0
Male...............	6,186,813	95.9
Female............	261,553	4.1
Owners..................	3,925,095	100.0
Male.................	3,737,326	95.2
Female...............	187,769	4.8
Managers...............	68,525	100.0
Male.................	67,762	98.9
Female...............	763	1.1
Tenants.................	2,454,746	100.0
Male.................	2,381,725	97.0
Female...............	73,021	3.0
Land in farms, total..acres	955,676,545	100.0
Operated by males.acres	929,878,145	97.3
Operated by females ....acres........	25,798,400	2.7
Average acreage per farm:		
All farms...............	148.2	......
Farms operated by males............	150.3	......
Farms operated by females...........	98.6	......

A GENETIC PORTRAIT CHART

According to Sir Francis Galton

In Which the Size of Each Likeness Shows the Proportion Which Each Ancestor Plays in the Children's Inheritance

DAVID FAIRCHILD

DID you ever find in the attic an old daguerreotype of some ancestor and wonder at the mystery of his blood relationship to you? Did you ever get together the photographs of all those whose actual bodily existences have contributed to your own? When you stop to think that these pictures of their faces are all that is visible today of those from whom you get your own nose, the cut of your chin, your expression, do they not seem worth preserving? Was it not after all into their faces that their friends looked to read their character when they were alive? They are not merely photographs of your grandparents as they sat for a moment in the studio of some forgotten photographer. They are the imperishable reflections cast by those wonderful personalities which have made you what you are.

In what proportion have these ancestors contributed to your particular person?

Sir Francis Galton, whose studies on human inheritance blazed the first real trail into this strange forest of ignorance, has shown that, if one should take a square to represent his total inheritance, one-half would represent the influence of his parents; one-half of what remained of the square would represent the influence of his grandparents; one-half of what still remained would be due to his great grandparents, one-half of the remaining portions to his great great grandparents, and so on in regular diminishing proportion.

This theory of inheritance, while not explaining many things, helps one to understand how quickly the influence of distant ancestors diminishes until, for example, that of a great grandparent is only one-sixteenth as much as a grandparent and only one-sixty-fourth that of a parent. To state the case in another way: the chances that one will resemble his great grandfather are only one-sixteenth as great as that he will resemble his father and one-fourth as great as that he will look like his grandfather.

HUMAN HEREDITY CHARTED BY PHOTOGRAPHS

Since the ordinary chart has too little in it that appeals to the imagination, I have covered each square with its corresponding ancestral photograph with the result shown in the accompanying Genetic Portrait Chart.

The bulk of people who are interested in the general subject of genetics are not familiar with the plants or animals on which geneticists are making their experiments (out of which are coming great discoveries). They cannot easily understand the significance of the hereditary changes which are quite apparent to the experimenters. They are accustomed, however, to looking at photographs of faces, and my idea in publishing this arrangement of my children's ancestors is to interest this class of the members in their own ancestors and get them to make Genetic Portrait Charts which will interest a considerable number of their own intimate friends and perhaps alter their point of view somewhat, bringing it more nearly in line with that of the

Note. This Genetic Portrait Chart was prepared by Mr. Fairchild for personal use, and he was naturally quite reluctant to publish it. On the ground, however, that it might arouse an interest in the subject of inheritance among those people who have little knowledge of plants and animals, photographs of which are featured in the Journal, the Council of the Association urged its publication. The system of designating relationships outlined by Dr. Bell in another article is used in this discussion.—Editor.

research men who are spending their lives in experiments to find out just how the hereditary machinery works.

The creation of better families is acknowledged to be an important step in the building of a better race, but this involves their starting by the union of good human stocks. May not the development of Genetic Portrait Charts arouse that interest in the family which must come before we can expect the creation of these better families and through them of the better race?

As pointed out in this Journal by Mr. Alexander Graham Bell "one certain means of increasing the prevalence of any hereditary characteristic in a community is to induce the individuals who possess it to marry one another." "The moment we have a body of desirable persons whose parents were also desirable, improvement of the race begins through the marriage of such persons with the normal population: for the proportion of desirable offspring born from the normal partners will be greater than in cases where the desirable partner had no ancestors belonging to the desirable class.

"The improvement will be still greater when we have a body of desirable persons who had grandparents as well as parents desirable; and still greater with each increase in the number of desirable ancestors."

RELATIVE INFLUENCE OF THE ANCESTORS

Inasmuch as one can read character in photographs and we have become very expert in doing this—for we have studied human faces all our lives—the grouping of all one's ancestors permits of a valuable comparison.

The proper arrangement places the man on the left side and the woman on the right, which throws all of the male ancestors into one line and the female ancestors into another for quick comparison. By looking to the right of Mrs. Fairchild, for example, there appear her mother, grandmother, and great grandmother in a straight line of descent. Each ancestor stands directly under his or her parents and the whole relationship of all the ancestors is evident at a glance. Naturally, if such a thing were possible, the ideal arrangement would be to have all of the photographs taken at the same age, say at 40, and from the same view.

By giving the data available as to the bodily characters of each ancestor which are known to be heritable, a more or less clear picture is obtainable of the stock from which the living representative has come.

That such photographs should interest a wide circle of people directly is evident on second thought, for the ancestry is that common to all the children of a family, for example, and all the children and grandchildren of those children. For example, my own ancestral photographs are common to four other children of my parents, fourteen grandchildren and two great grandchildren, or twenty people in all, whereas Mrs. Fairchild's ancestral photographs picture the ancestors of nine children. Together they should be of interest to twenty-nine persons besides the four living persons whose photographs appear among them.

This method of arranging ancestral photographs is capable of considerable expansion. It is true, for example, that in order to give as complete a picture as possible of the variations in the stock, photographs of all the brothers and sisters of both parents should be shown, since it is from a union of these two stocks that the children came. Children are almost as likely to resemble uncles or aunts as to resemble their own parents, and in a chart of this character the uncles and aunts should appear in the same scale as do the photographs of the parents.

A further refinement of the photographic chart would represent the brothers and sisters of the grandparents and even the great grandparents, which additions would make as complete a picture as possible of the family stocks which through their various unions have made the particular combination of characters seen in the living descendants.

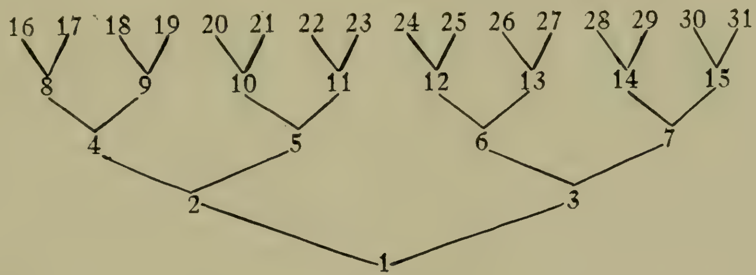
CONTROLLING THE NETWORK OF HUMAN INHERITANCE

As I look at these light reflections made by living beings, some of them a century ago, and realize that each one was the result of the union of the two (man and wife) who are directly behind him I am conscious of the resemblance of this whole structure to a network, a fabric stretching down from the distant past to the present. Each union of two souls is a knot in the network, and each individual life is a strand extending in time to the next union. And is it not a wonderful conception of human life to feel that we who still live are knots in a marvelous network of descent which has been running on since man first came into existence on this planet and which will go on until he ceases to exist here? Supposing millions could realize this and that their actions were affected by it as they are now by mysticism and that there should be inaugurated by youth throughout the world a study of this question of the unions of great human stocks, would not it lead to the building of superb strains of the human race? Is there any conceivable or at least reasonable method other than by our own conscious control of our children's inheritance to open the way to the birth of those superior human beings who we all believe are destined to inhabit this world after we are gone? Let every child study the network of his inheritance and learn to be proud of its longevity, its sturdiness, its intelligence, its lovableness, and its force of character, and when the time comes, he will hesitate to unite it with an inheritance less worthy.

To supplement this photographic arrangement with data giving such physical characters as are known to be heritable has proven a difficult undertaking, since the facts in many cases are unobtainable. Fragmentary as they are, however, they are given here to show the type of facts which might be included. Such characters as size, longevity, hearing, eyesight, complexion, baldness, color of hair and eyes, should certainly be given and, if possible, many others.

THE CHILDREN'S ANCESTORS

In this photographic study of the ancestry of Alexander Graham Bell Fairchild, Barbara Lathrop Fairchild and Nancy Bell Fairchild the system of Ancestral Numbers described elsewhere in this number of the Journal has been used. As they all have the same blood combinations, any one of them may be taken as the *propositus*, No. 1. The ancestors are then enumerated 2, 3, 4, 5, 6, etc. according to the following plan:



First parents (father and mother)

2. *Children's father*

David Grandison Fairchild 1869. Fourth of five children. Slender in youth (5 ft. 11½ inches); heavier at 45. Complexion clear. Hair light brown; beard reddish, not abundant, becoming gray early. Eyes blue, left one defective. Has worn glasses from boyhood. Hearing average.

3. *Children's mother*

Marian Hubbard Bell 1880. Second of four children. Slender (5 ft. 7 in.) Complexion olive. Hair black and abundant. Eyes dark. Eyesight un-

A GENETIC PORTRAIT CHART

ILLUSTRATING THE NETWORK OF HUMAN INHERITANCE

Showing in proper scientific relations those human beings whose combined heredities compose the actual inheritance of three American children. Is not every child entitled to see a clear picture of its ancestors, a visual representation of those who have contributed to its characteristics? Every space in the chart should contain a photograph. How many can you supply? The American Genetic Association is interested in assisting families in studies of their own heredity.

A person's total inheritance may be represented by a square. Each of the three children shown here is a product of the whole "square of inheritance" pictured above them. The top spaces should be further sub-divided as indicated in upper right corner.

Each horizontal line of photographs represents a generation. The relative influence of ancestors on the inheritance of the children is indicated by the size of the photographs, which become smaller with each preceding generation. (Fig. 7.)

usually good; slight muscular difficulty. Hearing excellent.

Second parents (grandparents)

4. *Children's father's father*

George Thompson Fairchild. Died in 63rd year. Tall (5 ft. 10½). Eyes intense black; eyesight excellent to 50th year. Hearing good. Musical. Hair black, turning gray. Bald forehead; dark complexion. Last born of 10 children.

5. *Children's father's mother*

Charlotte Pearl Halsted. Died in 67th year. Small and slim (about 5 ft. 6 in.). Eyes gray; eyesight good to 50th year. Hearing good until death. Hair light brown, not abundant. Delicate complexion. First born of eight children.

6. *Children's mother's father*

Alexander Graham Bell. 1847. Second of three children. Slender in youth; heavy in older age. Six feet. Olive complexion. Hair and beard black, abundant, turning white young. Eyes dark; eyesight perfect to 70. Hearing perfect to 70. Musical. Slight sense of smell.

7. *Children's mother's mother*

Mabel Gardiner Hubbard. 1857. Third of six children. Slender. Fair, clear complexion. Eyes gray, shortsighted from childhood. Hearing totally destroyed by scarlet fever at five. Hair light brown, abundant.

Third parents (great grand parents)

8. *Children's father's father's father*

Grandison Fairchild. Died in 99th year. Eyes black; eyesight good to 90th year. Hearing good to 90th year. Tall. Dark complexion. Hair dark, turning white; bald forehead. Third born of ten children.

9. *Children's father's father's mother*

Nancy Harris. Died in 80th year. Eyesight good to advanced age. Hearing good to advanced age. Hair auburn, not abundant. Medium size. Second born of seven children.

10. *Children's father's mother's father*

David Halsted. Died in 46th year after week's illness. Eyes blue. Hair black. Tall and slim. Clear complexion. Fourth born of five or six children.

11. *Children's father's mother's mother*

Mary Mechem. Died in 37th year. Eyes gray; eyesight defective. Hair light auburn, not abundant. Medium stature; frail. Delicate complexion. Seventh born of eight children.

12. *Children's mother's father's father*

Alexander Melville Bell. 1819–1905. Age at death 86. Slender in youth; heavy in old age. 5 ft. 10 in. Third of four children. Olive complexion. Hair black, abundant; reddish beard. Eyes dark; eyesight perfect to 80. Hearing perfect to advanced age.

13. *Children's mother's father's mother:*

Eliza Grace Symonds. 1809–1896. Age at death 87. Small and slight. First of large family (8). Light complexion. Hair becoming grayish. Eyes blue, deeply sunken. Eyesight good to advanced age. Hard of hearing from 10 years of age. Musical. Slight sense of smell.

14. *Children's mother's mother's father*

Gardiner Greene Hubbard. 1822–1897. Age at death 75. Tall and slim. One of large family. Complexion clear. Hair dark, becoming white. Eyes black, very short-sighted; wore glasses from childhood. Hearing perfect throughout life.

15. *Children's mother's mother's mother:*

Gertrude Mercer McCurdy. 1827–1909. 82 years old when killed in accident. Tall and slim. First of large family. Complexion clear. Hair soft brown, abundant. Eyes gray; suffered from cataract late in life. Hearing perfect throughout life. Musical.

Fourth parents (great, great grandparents)

Numbers 16 to 23 not given as portraits are lacking.

24. *Children's mother's father's father's father*

Alexander Bell. 1790–1865. Age at death 75. Tall, fine figure. Second of three children. Dark complexion. Eyes dark; eyesight good until advanced years. Hearing perfect to time of death. Heavy head of white hair in old age.

25. *Children's mother's father's father's mother*

Elizabeth Colvill. 1783–1856. Age at death 73.

26. *Children's mother's father's mother's father*

Samuel Symonds. 1776–1818. In poor health for several years and died of apoplexy at the age of 42.

27. *Children's mother's father's mother's mother*

Mary White. 1788–1872. Age at death 84. Light complexion. Hearing and sight good to advanced years.

28. *Children's mother's mother's father's father*

Justice Samuel Hubbard of Supreme Court of Mass. Data lacking.

29. Portrait lacking.

30. *Children's mother's mother's mother's father*

Robert Henry McCurdy. Age at death 80. Born 1800 died 1880. Data lacking.

31. *Children's mother's mother's mother's mother*

Gertrude Mercer Lee. Born 1809 died 1876. Age at death 67. Hair black, abundant.

THE SECOND INTERNATIONAL CONGRESS OF EUGENICS

A Conference on the Results of Research in Race Improvement

As has been previously announced the Second International Eugenics Congress is being convened this year, September 22–28 1921, at the American Museum of Natural History in New York City. This furnishes the first opportunity since the London Congress in 1912 for the geneticists and eugenists of the world to meet together for discussions of the results of their researches and their application to race improvement. Leading authorities rom most of the countries of the world will present papers on the vital problems relating to human welfare.

The officers of the congress are:

Honorary President

ALEXANDER GRAHAM BELL, Washington, D. C.

President

HENRY FAIRFIELD OSBORN, Columbia University and American Museum, New York

Honorary Secretary

MRS. C. NEVILLE ROLFE, London, England.

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Hon. Mr. Justice Frank E. Hodgins, Supreme Court of Ontario, Toronto, Canada.
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Dr. G. H. Knibbs, Melbourne, Australia.
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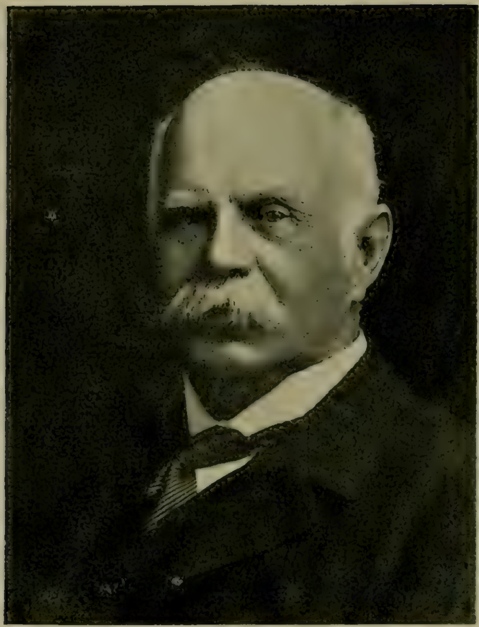
Dr. Jon Alfred Mjöen, Winderen Laboratorium, Norway.
Dr. T. H. Morgan, Columbia University, New York City.
Dr. R. Pearl, Johns Hopkins University, Baltimore, Md.
Dr. Edmond Perrier, Director, Jardin des Plantes, Paris.
Dr. Ernesto Pestalozza, Rome, Italy.
Prof. R. Vogt, University of Copenhagen, Denmark.
Prof. N. Wille, University of Kristiania, Norway.

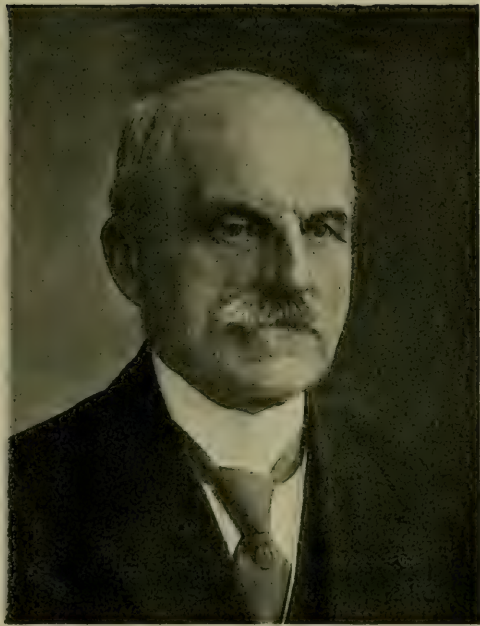
In the first section of the Congress will be presented, on the one hand, the results of research in the domain of pure genetics in animals and plants, on the other, studies in human heredity. The application to man of the laws of heredity and the physiology of reproduction as worked out on some of the lower animals will be presented

The second section will consider factors which influence the human family and their control; the relation of fecundity of different strains and families and the question of social and legal control of such fecundity; also the differential mortality of the eugenically superior and inferior stocks and the influence upon such mortality of special factors, such as war and epidemics and endemic diseases. First in importance among the agencies for the improvement of the race is the marriage relation, with its antecedent mate selection. Such selection should be influenced by natural sentiment and by a knowledge of the significant family traits of the proposed consorts and of the method of inheritance of these traits. In this connection will be brought forward facts of improved and unimproved families and of the persistence, generation after generation, of the best as well as the worst characteristics.

The third section will concern itself with the topic of human racial differences, with the sharp distinction between racial characteristics and the unnatural associations often created by political and national boundaries. In this connection will be considered the facts of the migration of races, the influence of racial characteristics on human history, the teachings of the past with bearings on the policies of the future. Certain prejudices directed toward existing races will be removed when allowance is made for the influence of their social and educational environment, and their fundamentally sound and strong racial characteristics are brought to light. On the other hand, limits to development of certain races and the inalterability through education and environment of the fundamental characteristics of certain stocks will be considered. Finally the advantages and disadvantages of the mingling of races, of unions which have proved fateful to social progress, should be discussed. In this section will be presented the results of research upon racial mixture in relation to human history. Also the topics of racial differences in diseases and psychology will be taken up. The history of race migrations and their influence



MAJOR LEONARD DARWIN
President Eugenics Education Society, London, England. (Fig. 8)



DR. LUCIEN MARCH
Directeur honoraire de la Statistique Générale de la France. Paris, France. (Fig. 9)

PROF. ERNESTO PESTALOZZA
President della Societa Italiana di Genetica et Eugenica, Rome, Italy. (Fig. 10)

DR. HERMANN LUNDBORG
Uppsala, Sweden (Fig. 11)

DR. MANUEL GAMIO
Mexico City, Mexico. (Fig. 12.)

DR. JON ALFRED MJÖEN
Winderen Laboratorium, Kristiania, Norway. (Fig. 13)

DR. N. WILLE
Chairman, Norwegian Consultative Committee for Race Hygiene, Kristiania, Norway. (Fig. 14)

PROF. VICTOR DELFINO
Buenos Aires, South America. (Fig. 15)

PROF. KRISTINE BONNEVIE
Universität, Kristiania, Norway. (Fig. 16)

DR. GIUFFRIDA-RUGGERI
Universita di Napoli, Naples, Italy. (Fig. 17)

on the fate of nations, especially modern immigration, should be set forth.

The fourth section will discuss eugenics in relation to the state, to society and to education. It will include studies on certain practical applications of eugenic research and on the value of such findings to morals, to education, to history and to the various social problems and movements of the day. In this section will be considered the bearing of genetical discoveries upon the question of human differences and upon the desirability of adjusting the educational program of such differences. Here will be considered the importance of family history studies for the better understanding and treatment of various types of hospital cases and those requiring custodial care. The bearings of genetics on sociology, economics and the fate of nations may be considered in this section.

In connection with this Congress a Eugenics Exhibit will be held including charts, maps, pictures, models and scientific apparatus so arranged that anyone of ordinary education may appreciate.

A few of the delegates from foreign countries are shown here; due to lack of time more photographs were unobtainable. It is regretted that space will not allow publication of the delegates from the United States.

The American Genetic Association is being represented at the Conference by David Fairchild and Sewall Wright.

HERITABLE CHARACTERS OF MAIZE

VIII. WHITE SHEATHS

J. H. Kempton
Bureau Plant Industry, U. S. Department of Agriculture

WHITE sheath is a variation in which the leaf-sheaths and husks fail to develop chlorophyll and remain white. The line of demarcation between the sheath and the blade usually is pronounced, though in extreme cases the white area invades the base of the blade, extending a few cm. on both sides of the midrib. In general, however, it is a characteristic confined to sheaths and husks.

The character varies not only in the degree of whiteness but also in the location of the first white sheath. In the most pronounced cases the fourth sheath is the first to exhibit the lack of chlorophyll while in other individuals as many as eleven normal green sheaths are produced before the appearance of the white ones. Five progenies which breed true for the white sheath character have been isolated and in these progenies there is a tendency to develop a red pigment in the sheaths after a few weeks exposure. This coloring probably in no way is attributable to the lack of chlorophyll, and appears equally intense in both the white and normal green sheaths, though naturally more conspicuous on the former.

STRIKING AS ORNAMENTAL PLANTS

Plants which develop the white sheath character early and to a marked degree are very striking and like the Japonica striped strains may be of value as ornamentals. The most extreme strain that has been isolated shows the character to be detrimental to vigorous growth, although no reduction in vigor is noticeable in plants of moderate whiteness.

A HERITABLE CHARACTER

The character appeared simultaneously in two sister progenies of a Pawnee variety, the original ear of which was obtained from M. R. Gilmore of Lincoln, Nebraska. These progenies were the result of self-pollinating the original strain for two years. In both progenies the number of plants with white sheaths indicated that the character was a simple Mendelian recessive, the actual counts being 29 green 11 white sheaths and 30 green, 12 white sheaths respectively. The two progenies, however, differed markedly in the degree of whiteness, one having the color of the sheaths and blades sharply contrasted while in the other the sheaths were noticeably greenish. Individual plants in both progenies varied in the degree of whiteness and subsequent progenies show the differences to be heritable.

Self-pollinated seed from white sheath plants produced only plants with white sheaths but self-pollinated sister green plants or green plants from sister progenies do not give uniformly Mendelian ratios. This is shown in Table I, where the progenies of self-pollinated green plants are classified.

TABLE I: *Classification of the progenies of self-pollinated green plants which produced some plants with white sheaths. The first four progenies are descended directly from the strains in which the white sheaths first appeared while the others are from sister progenies.*

Character of Parental Progeny	*Number Green*	*Number White Sheaths*
Sheaths and blades sharply contrasted	67	13
Sheaths and blades sharply contrasted	23	8
Shealthes and blades poorly contrasted	53	3
Sheaths and blades poorly contrasted	60	3
Sheaths green	51	2
Sheaths green	32	3
Sheaths green	67	3
Sheaths green	69	2
Sheaths green	50	7

The deficiency, from the standpoint of a simple Mendelian character, of

LEAF SHEATHS OF MAIZE

The white sheath in maize is a variation in which the leaf-sheaths and husks fail to develop chlorophyll, thus remaining white. The character varies in degree of whiteness and has been found to breed true. Plants with white sheaths are striking in appearance and may be of use as ornamentals. The sheath at the right in the photograph is without chlorophyll although the blade is normal green. Natural size. (Fig. 18.)

white sheath plants, may be due to the variability in expression resulting in an improper classification.

Crosses have been made with plants of other chlorophyll variations and the first generations of such crosses invariably are normal green in color. Even in crosses with the variegated Japonica strains where the stripes commonly appear on the sheaths as well as the blade, often resulting in a wide white band on the sheath, the first generation plants have normal green sheaths. In a small population of a second generation hybrid between white sheaths and Lineate the white sheath character reappeared but as yet the numbers are too small to indicate relationships. A stock of seed of this white sheath variation has been obtained and a limited quantity will be supplied to interested investigators.

RECORDS SHOW NO RADICAL CHANGE IN SEASONS

"The seasons are changing; we do not have the cold weather we did when I was a boy." Remarks similar to this are frequently heard by representatives of the Weather Bureau, United States Department of Agriculture, but reports on the weather dating as far back as 1780 show that there has been no radical change in the mean temperature from year to year.

An official of the Weather Bureau has compiled the following table from records taken by various observers previous to 1872 and from those of the Weather Bureau Station at New Haven, Conn., from 1873 to the present.

For the 10 years ending—	Mean temperature
	°F
1790	49.6
1800	50.0
1810	50.4
1820	47.5
1830	49.3
1840	47.8
1850	49.2
1860	48.9
1870	49.1
1880	49.7
1890	48.9
1900	49.7
1910	49.7
1920	50.5

It will be noted, the official points out, that the warmest three periods are those ending in 1800, 1810, and 1920, and that the coldest decade immediately follows the second warmest.

Considering the individual months and the individual years, it is found that the coldest January occurred as late as 1857. The coldest February occurred eight years after the warmest one. The coldest March was as late as 1870 and again n 1885. The coldest April was in 1874, and many years after the warmest one. The lowest temperature in May was in 1812, 1815, 1870, and 1882. The highest figures in June are in 1779, 1790, 1803, and 1876. In July the lowest was in 1816, with the warmest as early as 1780 and equaled in 1876. The coldest August occurred 61 years after the warmest. In September the coolest months are in the earlier years, but for October, November, and December the coldest year came after the warmest year in each case.

Thus it will be seen that in nine months of the year the coldest one of record occurred after the warmest one. These figures seem to indicate very clearly, the weather official says, that since the time of the Revolutionary War, at least, there has been no permanent change in temperture.—*Weekly News Letter, U. S. Dept. of Agri.*

BUD VARIATION IN ELEAGNUS

C. S. Pomeroy
Riverside, California

THERE are a large number of ornamental Evergreen plants that are quite generally grown in Southern California and several of them have forms with variegated foliage which are usually considered to be much more beautiful than the solid green forms. These plants are commonly propagated by cuttings of mature or half-ripened wood and so far as the writer has been able to learn all the variegated forms have originated as bud variations in plants of the typical green forms. Descriptions of some of these variations have been presented in these pages during the past few years, together with illustrations showing instances of the various green and variegated forms occurring on the same individual plants.[1] Similar instances of variegated variations in orange and lemon trees have also been described and illustrated.[2]

ATTRACTIVE FOLIAGE OF VARIEGATED FORMS

Two variegated forms of the shrub *Eleagnus pungens* have come to the attention of the writer in one of the city parks of Riverside, California, and in both instances branches have been found on the plants that are made up entirely of non-variegated leaves showing a reversion to the solid green forms from which the variegated forms doubtless arose as bud variations.

The various species of this genus represent a group of shrubs or small trees that are grown chiefly for their handsome foliage and decorative fruits and the variegation of the two forms mentioned makes the varieties particularly attractive and desirable as specimen plants or in ornamental groups or hedges. In one of these forms, variety *Frederici variegata* (fig. 1), the light colored areas occur as irregular streaks or blotches in the centers of the leaves, and in the other form, variety *aurea* (Fig. 2), the light color is usually confined to the margins of the leaves, though frequently the chlorophyll disappears from larger areas, sometimes absent from the entire leaf.

Eleagnus pungens is a spreading shrub, ordinarily considered as reaching a maximum of six feet in height but one of the specimen plants with which the writer is familiar is fully 15 feet high. The branches are reddish brown and usually spiny, the leaves are alternate, short-petioled, entire, oval or oblong, with both ends obtuse, undulate and often crenulate at the margin, clothed with silvery scales when young, at length becoming glabrous above, silvery beneath, more or less interspersed with brown scales, two to four inches long. The flowers are inconspicuous but fragrant and are borne in the fall in axillary clusters. They are apetalous and perfect, the tube cylindrical, slightly narrowed at the base, longer than the limb, perianth 4-lobed, stamens four, included, on very short filaments. The fruit is a 1-seeded false drupe, red when mature, short-stalked, about three fourths of an inch long, covered with

[1] Shamel, A. D.
A Bud Variation of Pittosporum. Jour. Hered., Vol. 8, No. 8, Aug. 1917, p. 357–358.
A Bud Variation of Euonymus. Jour. Hered., Vol. 8, No. 5, May, 1917, p. 218–220.
Origin of the Striped Cane. Jour. Hered., Vol. 8, No. 10, Oct. 1917, p. 471–472
Origin of the Striped Oleander. Jour. Hered., Vol. 12, No. 1, Jan. 1921, p. 42–45.

[2] Shamel, A. D.
An Orange Bud Variation. Jour. Hered., Vol. 8, No. 4, April, 1917, p. 176–177.
Shamel, A. D., Scott, L. B., Pomeroy, C. S., and Dyer, C. L.
In Citrus Fruit Improvement: A Study of Bud Variation in the Eureka Lemon. U. S. Dept. Agric., Bul. 813. See p. 21–22 and pl. V.

BRANCHES FROM A SHRUB OF Eleagnus pungens var. aurea (Servettaz), AN OLEASTER

At the left are some typical leaves with light colored margins. At the right are two small branches bearing leaves that show no chlorophyll, and in the center is shown a branch which has sported back to the original solid green color, none of the leaves on it showing any variegation. Plants with variegated foliage are usually much more beautiful than the solid green forms. (Fig. 19.)

A LARGE BRANCH FROM A SHRUB OF Eleagnus pungens var. Frederici variegata (Servettaz), WITH VARIEGATED FOLIAGE

The foliage on this plant is normally solid green in color, but variegated forms have originated as bud variations. The three upper small branches in the illustration are shown sporting back to the solid green leaf color of the type of this species. At the bottom is a twig which has leaves of the solid green color along one side and variegated leaves along its opposite side. (Fig. 20.)

silvery or brownish scales. This species is native to Japan and China and is hardy only in the southern part of the United States.

Servettaz describes the flowers of the variety *aurea* as differing from the type species in having larger lobes which are quadrangular instead of of triangular, the tube is not narrowed at the base and no fruit is produced. The writer has not had an opportunity to observe whether or not the specimens of *aurea* will fruit under conditions at Riverside.

CLASSIFICATIONS DIFFICULT

This genus, Eleagnus, gives its name to the Oleaster family (Eleagnaceae) the word being an ancient Greek name meaning a kind of willow, from *Elaios*, olive. In European countries this genus is known as the wild olive from the resemblance of its most common species to the true olive, though the two plants belong to entirely unrelated families. Plants of the oleaster family are distinguished by their peculiar scales, perigynous flowers, the l-celled, l-seeded ovary and the fleshy but free receptacle.

No less an authority than J. D. Hooker wrote that "in no genus of shrubby flowering plants are the species more difficult of definition by characters of habit and foliage than are those of Eleagnus." The tedious task of monographing this genus has been painstakingly accomplished by Dr. Camille Servettaz.[3]

He states that (translated) "The division of the genus Eleagnus into species presents great difficulties, for certain species distributed over large geographical areas and under different climates show extreme variations which it is sometimes almost impossible to classify. In order to definitely determine a plant of this genus it is necessary to know, for example, if it flowers in spring or autumn, if its flowers appear at the same time as the leaves or later, if they are located at the base, at the top or along the entire length of the branch, if its leaves are persistant or not, if its floral stem continues its growth or remains unchanged during the ripening of the fruit, etc., etc. It is by these biologic characters that specific determinations are most certainly established much more than by morphological characters for the representatives of the genus are variable enough when following the mean."

It is quite possible that many of the different forms which were such a puzzle to Servettaz in his systematic classifications were of the type of non-heritable variations due to climatic or other causes but it is also quite possible that some of them were true bud variations. Indeed Servettaz recognized this possibility in establishing a species *submacrophylla* which he characterized as comprised of "various midway between *E. pungens* and *E. macrophylla*, which were doubtless hybrids or mutating forms."

In any event there is no doubt of the bud origin of the variegated forms described and illustrated herewith nor of their commercial stability during successive bud generations under the continual asexual propagation of ordinary horticultural practise.

[3] Monographie des Eleagnacees in Bot. Centralblatt, Beihefte 25, pt. 2, p. 1–128 (1908).

Friendship and Sexuality

Freundschaft und Sexualität, von Dr. Placzek, Nervenarzt in Berlin. Fünfte, fast unveränderte Auflage. Pp. 160, preis M.12. Bonn, A. Marcus and E.Webers' Verlag, 1920.

Dr. Placzek's book, which seems to have attracted a good deal of attention in Germany, offers little of special interest to the geneticist. His thesis is that friendship is largely based merely on the attraction of personalities, and that modern psychologists who attempt to read a sexual element into all types of friendship are in error.—P. P.

MEASURING HUMAN INTELLIGENCE

"Why should we not ascertain the grade of intelligence necessary in every essential occupation and then entrust that work only to those people who have the necessary intelligence?" Dr. H. H. Goddard thinks this would not be difficult to do. His convincing book is here reviewed.

PAUL POPENOE

WHEN psychologists announced, after examining 1,700,000 men, that the average mental age of men in the army was about 13 years, they attracted widespread attention to the doctrine of mental levels. But, says Dr. Goddard, let us not commit the fallacy of the average. "The average only means that there are about as many of lower intelligence as of higher.

"We have seen that while the average is perhaps thirteen to fourteen years and there are 25,000,000 people of this intelligence and 45,000,000 still lower, there are also 30,000,000 above the average and 4,500,000 of *very superior intelligence.*"

Dr. Goddard discusses at some length the way in which these levels of intelligence are measured, and the validity of the methods used.

"The theory of mental levels holds," he says, "that every human being comes into the world with a potentiality for mental development that will carry him just to far, and that barring those accidents that may stop a person from reaching the development that would have been normal to him, nothing can, to any great extent, affect the mental level to which he will finally attain.

"Why is this view hard to accept?"

KNOWLEDGE VS INTELLIGENCE

"Probably the first and most important reason is that we have generally confused intelligence with knowledge. Having no way to evaluate either one we have been lost in the intricacies and confusion results. . . The second important reason why the theory of mental levels is hard to accept is to be found in the fact that while we know children generally increase in intelligence from birth to maturity, we have never appreciated the exceptions."

There are many theoretical grounds for believing that intelligence develops, and that it can be tested; but in Dr. Goddard's opinion the army experience, in which the results of the tests coincided so well with the actual experience and observation, put the doctrine beyond argument. "With this army experience it is no longer possible for any one to deny the validity of mental tests, even in case of group testing and when it comes to an individual examination by a trained psychologist, it cannot be doubted that the mental level of the individual is determined with marvelous exactness."

Such considerations throw real light, the author thinks, on the search for national efficiency. For the first time Society has an instrument with which to work. If the mental level of every individual in the nation should be determined, it would be possible to apportion the available jobs intelligently, preventing good men from wasting their time on inferior jobs, and protecting the public from having mentally inferior persons in positions of responsibility, where they now often are.

"It is natural to raise the question just here as to whether it would

[1] HUMAN EFFICIENCY AND LEVELS OF INTELLIGENCE, by Henry Herbert Goddard, director of the Bureau of Juvenile Research of Ohio. Lectures delivered at Princeton Univ., April, 1919. Louis Clark Vanuxem Foundation. Pp. 128. Princeton Univ. Press, 1920.

not be a serious humiliation for an individual to discover that he has not sufficient intelligence to undertake a given line of work. The reply is first, whatever the momentary humiliation, it can never compare with the humiliation of failure that is sure to come later, or with the unhappiness that is the constant accompaniment of worrying through the years working at a task that is beyond one's ability.

"The second answer is, that it is only a question of custom and frequency. For a single individual to be pointed out as not having sufficient intelligence to become a doctor while the rest of his group were supposed to have the requisite intelligence, would be somewhat humiliating; but if the intelligence of each member of the group were determined and all were found to have approximately the same, even though it were below that required for a particular profession would not be humiliating. Moreover, it is not so new and strange as it first appears. Many people today are advised not to undertake this or that profession or business because they have not the requisite qualifications. The application of the facts of mental level is only a more scientific way of getting at the same result."

THE INFLUENCE OF EMOTIONS

It has, of course not infrequently been objected that the mental level of a person is not sufficient; that the emotional nature is quite as important. The man of violent emotion is liable to be inefficient through a wasting of his energy in emotional outbursts, while the man of weak emotions is apt to be inefficient because he does not have the emotional stimulus to hold him up to his capacity. Besides that, the man who is emotionally despondent or chronically unhappy does not do good work, and tends to make others unhappy as well as himself.

"While all this is profoundly true, it must not be overlooked that the level of intelligence to a large degree determines the extent to which the individual either controls these tendencies of his emotional life or fails to control them. Nor must we forget the danger of reasoning in a circle here, since much of the chronic unhappiness is directly traceable to the fact that the individual is attempting to do a work for which his intelligence is not equal. Again, many times the emotional outbreak is due to an uncongenial environment which a better intelligence would prompt him to change. Still better, as we shall see later this emotional condition has a physical basis, which while sometimes beyond control, is nevertheless in many cases capable of being modified by a use of sufficient intelligence. So that while, in view of these facts of the emotional life, we may not say that one's efficiency is entirely proportionate to his mental level, we can at least feel safe in declaring that a low level will exercise little or no control over the emotional life and therefore, those instincts and emotions which would tend to inefficiency will have their full force instead of being modified and controlled as they are by higher intelligence. So that in determining the mental level of an individual, we are ascertaining how much power of control he has over these fundamental instincts and emotions, a fact which is obviously of no small value."

But, it is asked, are these levels fixed and unchangeable? "To take a concrete example, suppose a young man has the ambition to become a physician. Even though he should find he has a low mental level, emotional peculiarities and temperamental idiosyncrasies, will not his ambition make up for all these negative conditions, so that he succeeds in spite of them? The reader will undoubtedly be able to cite instances that seem to indicate that this is the fact, but because the mental level has never been determined in these cases, it is possible to say they are not cases in point because the mental level may have been adequate to the accomplishment of the task, and consequently it was not a case of the ambition or the circumstances

overcoming mental weakness. Moreover, we are compelled to conclude that this is actually the situation because of what we know of the nature of intelligence. This comes from the fact that these conditions we are discussing are definitely determined by a physical condition which is, to a high degree unchangeable.

"The study of feeblemindedness has confirmed our belief that intelligence is a matter of brain cells, and neuron patterns, and still more definitely, it is a question of the development of the larger association areas of the brain the functioning of which develops relatively late, and hence this development is particularly liable to arrest; moreover, when such arrest has taken place, there is no evidence that it ever starts up again. This means of course, that once a person's mental level is determined, there is no known method of changing it."

GREAT NUMBER OF MISFITS

In the light of this doctrine, "it is easy to see why human society is relatively inefficient. Knowing nothing of mental levels beyond a crude appreciation of the fact that some men are certainly more intelligent than others, we have made no serious attempt to fit the man to the job."

"When one contemplates the enormous proportion of misfits that must exist in the industrial world and that such misfits mean discontent and unhappiness for the employee, one can but wonder how much of the present unrest in such circles is due to this fact. A man is doing work that is well within the capacity of his intelligence and yet that calls forth all his ability is apt to be happy and contented and it is very difficult to disturb any such person by any kind of agitation."

One of the most serious phases of the problem concerns the lowest 10%. These make up the delinquents.

"A delinquent is literally one who has been left behind." He is "the one who does not come up to the mark in the performance of those duties which the group has placed upon every member." Hence he is a tremendous drag on the efficiency of the group. The recognition of the doctrine of mental levels will make it much easier to deal with these, and preventive methods that can be rationally applied may be counted on greatly to cut down the cost of caring for the feebleminded.

CAN THERE BE A DEMOCRACY?

But looking at the larger problem, what about democracy itself? Can we hope to have a successful democracy where the average mentality is 13?

There are, as was pointed out at the beginning of this review, thirty million above the average, and 4,500,000 of very superior intelligence. "Obviously there are enough people of high intelligence to guide the Ship of State, if they are put in command.

"The disturbing fear is that the masses—the 70,000,000 or the 86,000,000—will take matters in their own hands. The fact is, matters are already in their hands and have been since the adoption of the Constitution. But it is equally true that the 86,000,000 are in the hands of the 14,000,000 or the 4,000,000. Provided always that the 4,000,000 apply their very superior intelligence to the practical problem of social welfare and efficiency.

"Lower intelligence will invariably and inevitably seek and follow the advice of higher intelligence so long as it has confidence in the individuals having the higher intelligence. That is a proposition so invariable as to be recognized as a law of human nature. . . Whenever the 4,000,000 choose to devote their superior intelligence to understanding the lower mental levels and to the problem of the comfort and happiness of the other 96,000,000 they will be elected the rulers of the realm and then will come perfect government—Aristocracy in Democracy."

In passing, Dr. Goddard suggests that the feebleminded ought not to be allowed to vote. He then considers the equalitarian ideas that lead to

Bolsehvism, pointing out that "the different levels of intelligence have different interests and require different treatment to make them happy, and we are committing a serious fallacy when we argue that because we enjoy certain things, everybody else could enjoy them and therefore ought to have them." Social equality is psychologically impossible.

MENTAL LEVELS OF SCHOOL CHILDREN

"We must now consider what is the wise procedure with the various low levels of intelligence. As we stated in an earlier lecture, all work looking to the eventual control of this problem of social efficiency as conditioned by mental levels, must begin with the children. When children enter school their mental level should be determined. Several groups will be found. At the top are those who are exceptionally intelligent, well endowed, who test considerably above their age. This group subdivides into two: first, those who are truly gifted children and second, those whose brilliancy is coupled with nervousness. The superior mentality of the truly gifted will mark them throughout life. They should have the broadest and best education that it is possible to give, not necessarily hurried through the grades at the most rapid rate but while advancing somewhat faster than the average child, they should be given a broader experience. There should be opportunities for them to do many things, in each year, that the average child has not time to do.

"The nervously brilliant group is a very important one. It contains those children who are brilliant in school but whose brilliancy is evidently due to a very high-strung nervous system. It is a case of the well-known but little understood relationship between genius and insanity. While these children may probably not be called insane they are nevertheless in a stage of nervous instability which, while it happens to make them keen, acute, and quick, and they give the appearance of brilliancy; on the other hand it is an exceedingly dangerous situation since experience has taught that a little pushing or overwork may very easily throw them over definitely on the insane side. These children should be treated with the very greatest care.

"A second group comprises the moderately bright children, a little above average and yet not enough to be considered especially precocious. They should, however, have their condition taken into account and they should not be compelled to drudge along with the average child.

"Then comes the *average child* for whom our school systems are at present made, and the only group whom they adequately serve. The question whether the training that we are giving this group in the public schools is the best that can be devised is not for us to discuss here.

"Our next group is the backward. Those children who are not quite up to age, who have considerable difficulty in getting along with their work and yet who do get along after a fashion. This group should be carefully watched from the start and eventually they will differentiate again into two divisions, possibly three. Perhaps some of them may later on catch up with the average child. Some of them will go through their whole educational career with the same slowness, nevertheless they will get through. There are still others, who while only a little backward at this first examination, later on will show that they are actually feebleminded children.

"Finally there is the group of definitely feebleminded. In many cases it will not be possible, at this time, to predict what their final mental level will be. This group will ultimately divide into several grades according to their mental level. There will be the morons with their three or four subdivisions, that is to say, those who have a mentality of eight, those of nine, or ten or eleven, perhaps of twelve. Then come the imbeciles with their mentality of seven and six and five;

and each of these should receive special training and treatment.

"The lower grade imbeciles will probably not get into the school but will be recognized at home as defective and kept there until they can be placed in an institution for the feebleminded.

FITTING THE TASKS TO THE CHILD

"Now it is impossible to decide from this single examination of the children on entering school just what kind of training is best for each one. Consequently with many of them it will perhaps be necessary to start with the regular work of the first grade, but they must be carefully watched and if it is found they are not progressing like the other children then they should promptly be placed in the other group where children are taught to do things rather than to read and write about things.

"The group that is recognized as distinctly feebleminded should not be worried with reading and writing at all, but should at once be placed in a group where they will be taught various activities. The purpose of this kind of training is twofold, first to develop physical coordinations and second to train them to do useful things. They may all be started at the same point but the relatively brighter ones will progress faster and should the more quickly get on into industrial and vocational training.

"The starting point for these cases is the care of their own person. These children generally have not been taught to wash their faces and hands and comb their hair, still less to bathe. These matters should be carefully taught until they become habits." Then comes dressing, taking care of their rooms, sewing and the like. A few may even learn to read and write. Those that are diagnosed definitely as feebleminded should be committed to some suitable institution. Many of them may be taught some industrial occupation and "graduated" into useful places in society.

WHEN TO GIVE MENTAL TESTS

"Coming back now to those children who are at age or above age and are doing regular school work, they should be given mental tests whenever it is proposed to promote them to an advanced grade. It will thus be ascertained whether they have the mentality for doing the work of that grade. Whenever it is shown that they have not the capacity, they should be transferred to special work within their capacity, and their development carefully watched.

"When it comes to high school it is most important that their mental level be determined, because there are many children who get through grammar school fairly well but have not the mentality for high school work. This fact should be determined and these people allowed to leave school and go into industries rather than be forced on into high school. Again, each year in the high school probably requires a higher level and some will fall out at each step. This brings us to the college. There is a prevalent idea that every child who has the means and gets through high school should go to college. The teachers in college have long known that many who enter should never attempt to do college work."

MENTAL TESTS FOR OCCUPATIONS

The same principle might be applied, Dr. Goddard thinks, to the various professions and occupations. "Why should we not ascertain the grade of intelligence necessary in every essential occupation and then entrust that work only to those people who have the necessary intelligence? This would not be at all difficult to do. It would in some cases require considerable labor, but that is all. For example, how much intelligence does it require to be a Motorman on a street car? To ascertain this, it is only necessary to give mental tests to all the motormen, and then ascertain from employers which ones are highly successful, which ones moderately successful, and which prove to be failures.

It would then be discovered that men of a certain mental level fail, men of another mental level are fairly successful, men of still a third mental level are highly successful and efficient."

To carry the principle further, "society not only has a right to protect itself but it seems clear that society has a right to take any action necessary to attain the highest social efficiency. If this is true, why should we not ascertain the mental level of people in various activities and when we find any inefficient, clearly on account of their lack of intelligence or other qualities, why should not society have the right to transfer that individual to some other line of work where he would be more efficient? This may be too advanced step to be taken at once but it will surely come to that eventually. Such a procedure would work no hardship on the individual because in the long run it would actually increase his happiness and lengthen his life, for there is nothing more deadening and discouraging than to be compelled to work at something where one is conscious that he is inefficient. Many a person is inefficient because of an uncongenial environment which a better intelligence would prompt him to change. Moreover, this emotional condition has a physical basis which, while sometimes beyond control, is nevertheless in many cases capable of being much modified by the use of sufficient intelligence."

Dr. Goddard then goes on to deal with the problem of the delinquents, proper treatment of whom would largely reduce crime and immorality, with an accompanying lessening of the expense of government.

In stating clearly—even baldly—the doctrine of mental levels and pushing its application to a logical conclusion, Dr. Goddard has done a real service to biology. The easy readability of the book—in spite of defects of style—will appeal to non-technical readers, who will find in it food for many thoughts. One need not agree with all the author's statements, to agree with him that the recognition of the innate and inalterable differences among human beings is fundamental to social progress. This will eventually make it possible "for the intelligent to understand the mental levels of the unintelligent, or those of low intelligence, and to so organize the work of the world that every man is doing such work and bearing such responsibility as his mental level warrants."

The Experience of a Clinical Psychologist

MENTAL HYGIENE, two years' experience of a clinical psychologist. By Lillien J. Martin, Ph. D., Pp. 89, Price $1.40. Baltimore, Warwick and York, 1920.

Clinical work in mental hygiene is a relatively new development, that has attracted much public interest. Dr. Martin in this little book tells just how it is done. Her frank and detailed exposition is presumably intended for other psychologists who may wish to work up a "practice"; but it will be equally valuable and intensely interesting to laymen who seek information about this young and important field of science. Any intelligent adult could read this book with pleasure and profit. P. P.

A LIVING DOUBLE-HEADED CALF

William M. Goldsmith, Ph.D.,
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ON MARCH 12, 1921 a grade cow belonging to Edd Ellis, Arkansas City, Kansas, gave birth to a living female double-headed calf. The calf was sold to E. J. Dewitt, 824 North C. St., Arkansas City, Kansas, and put on exhibition in the various towns of southern Kansas and northern Oklahoma. Although an admission of twenty-five cents was charged to see it, hundreds of people were attracted daily. In view of the fact that this calf is still living (July 10, 1921) and feeding through both mouths, it seems of sufficient interest to warrant a brief description.

The calf is normally active and playful but since the only two eyes which are functional are located far to the outer sides of the double head, it presents an awkward appearance when moving about. It cannot see directly forward and therefore turns the head in such a way as to use one eye at a time. When food is offered the calf, it comes forward in an awkward and hesitating manner and nibbles away with both mouths, finally taking in the food through either opening. Figure 22 shows the calf eating hay with the right mouth, the left mouth holding a few straws picked up in an accidental way. The calf is here standing slightly to the left of the hay making it more convenient to use the right mouth.

The most abnormal behavior of this calf is a staggering movement of the posterior part of the body. This is more noticeable when it moves about slowly after being disturbed from a rest. The neck, limbs, and body are well built with no abnormal features. The posterior part of the head articulates with the cervical vertebrae in the usual manner. Since the head is almost flat on top and broadens out to its maximum size near the eyes, the top of the skull presents the appearance of a half-hexagon. The forehead is very full above the division line of the two faces. The nose, upper lips, and nostrils are normal in both heads.

THE MEDIAN DOUBLE EYE

The bivalent nature of the head first expresses itself in the large median double eye socket (Fig. 22). On either side and below the double eye, there are two complete faces connected by a bony bridge to within three inches of the nostrils. The connecting bridge is slightly convex, leaving a depression between the median line and either head (Fig. 22). The two superciliary ridges are normal except directly above the median double-eye socket where they fuse in an abnormal way. The ossification below the double-eye continued until a triangular bony socket was formed. The growth of the skin above the double-eye corresponded with that of the bones. The two upper eye-lids are quite complete, fusing at the top in such a way that the normal lashes from either side cross each other in the upper angle of the double-eye. These upper eye-lids appear quite normal but exhibit no movement. The growth of the skin below the double-eye was so abnormal that no lower eye-lids were formed. Under the eye, the skin has grown up higher in the center than at the lower angles, thus giving the median eye the form of an inverted V. The V-shaped median-eye-socket contains two eyeballs, the inner surfaces of which are in contact. These eyeballs seem to be in a state of atrophy. During the first two weeks of the calf's life they seemed fairly normal. Later they began to turn white until now they are covered with a scaly layer. Each of these eye-balls has an independent movement, indicating that there are two sets of functional muscles.

A LIVING DOUBLE-HEADED CALF

This calf was born in Kansas on March 12, 1921. A remarkable fact is that it has lived and functions sufficiently to sustain apparent normal life. The double head is its only abnormal feature. It is able to eat through either of the two mouths, but only two eyes are useful, and these are situated on the outer sides of the double head. Thus it cannot see directly forward without turning the head sideways, and this causes very awkward movements in walking. (Fig. 21.)

TRIVALENT LOWER JAW

The division of the ventral part of the head is less complete than is that of the dorsal. The lower lips are divided as are the upper lips, but the jaws are fused and crowded and, in general, very abnormal. This fused condition is so marked that the entire compound lower jaw moves in unison. The right side is much nearer normal than the left. The lower incisors, for example, are straight and in a normal position except those on the left side, which are quite irregular owing to the crowded condition at the median fusion line.

The left lower jaw, however, shows signs of further division. There are parts of two sets of incisors. The most interesting feature in this connection is the fact that the two incomplete lower jaws on the left side are not closely articulated but have a slightly independent movement. When the calf chews, the jaw of the right head and the right jaw of the left head move solidly together since they were fused by ossification, while the incomplete jaw on the left side of the left head has a slightly independent action. This, however, is not great enough to interfere with mastication on that side.

The muscular partition between the two mouths is complete but there are no indications of a division between the two rudimentary jaws of the left side.

THE UPPER JAWS AND MOUTH

The upper jaw-bones of each mouth seem quite normal except for the absence of the front teeth. The molars in both mouths articulate in the usual manner. The median double set, however, are crowded against the median muscular partition. The partition protrudes slightly out of the mouth (see Fig. 23) and is characterized by its numerous papillae, many of which are fully one-fourth of an inch long (Fig. 23). Both tongues are normal in appearance except that they are attached more to the median partition than to the outer sides. This gives them an awkward inward movement. The two tongues and the fused jaws have a unified movement. The movements of the parts of the mouth containing no food is identical (except for the slightly loose third jaw) with those of the one feeding. In fact, the two muscles of the tongues seem to converge to a median region.

Although the four nostrils (Fig. 23) are normal, the internal structures surrounding the respiratory passages are very irregular. The most noticeable abnormality in this region is the unusually large cleft in the upper palate of the right mouth, while on the left side the palate is over-developed, almost closing the air passage.

Since it was not possible to study the internal structure of the throat and neck, further analysis was impossible. It would be exceedingly interesting to make a minute anatomical study of the specimen under consideration so that a comparison could be made with somewhat similar abnormalities which have been described.[1]

[1] Albert M. Reese, "The Anatomy of a Two-headed Lamb" Anat. Rec. V. 13, No. 4.

"The Anatomy of a Double-Cat" Anat. Rec. V. 5, No. 8.

Williams and Ranch, "Anatomy of a Double-pig" Anat. Rec. V. 13, No. 5.

E. Carey, "Anatomy of a Double-Pig," Anat. Record, Vol. 12, No. 1.

EATING THROUGH TWO MOUTHS

The calf is shown here eating hay with its right mouth, probably because that side of its head was nearer to the hay. A few straws may be seen in the left mouth. (Fig.) 22.

HOW THE JAWS ARE FUSED (Fig. 23.)

UNCLE SAM'S MODEL VILLAGE

A report on the model health department in the model village which the U. S. Public Health Service has been developing for nearly two years on the 516-acre Government reservation at Perryville, Md., shows some interesting facts.

The reservation was used during the war as a site for a huge nitrate plant. The buildings included 200 cottages, two general stores, a model school house, club, firehouse, and theater for the employes. The whole reservation was turned over by Congress to the Public Health Service for a hospital site and for the storage of the vast quantities of medical stores required for the U. S. Public Health Service hospitals.

The Public Health Service promptly transformed a group of cottages into one hospital and set to build another, the whole now accommodating 430 patients. Not including the somewhat variable hospital quota the reservation now has a population of 839 persons, about equally male and female, with many children and few aged.

The birth rate on the reservation was 39.33 per thousand, as against 24.39 in the whole State and 28.78 in the county. The death rate was only 3.67, the excess in children being probably about balanced by the deficiency in aged persons. While this low death rate is partly due to the favorable age constitution of the population, much of the credit belongs to the efficient health administration.

Careful work has kept the record of communicable diseases low. Particularly was this the case with diphtheria, of which an outbreak was reported early in the year in the village outside the reservation, across the railroad track, from which many workmen came daily to the plant. The Schick test showed that one third of the children in the school were susceptible to the disease; and all of these were promptly immunized by a new method. Three months later a second test showed that only three still remained susceptible.

During the year 30 cases of diphtheria occurred in the county and three on the reservation, one of them a new comer, one a young sister of a boy who was found to be a carrier, and one an adult.

The low prevalence of contagious disease is ascribed directly to close watch and prompt isolation, laboratory diagnosis, and prophylaxis; and indirectly to pasteurized milk, filtered and chlorinated water, school medical supervision and good living conditions, including sewers, screens, and covered garbage cans.

A physical examination of the children showed that 93.5 per cent had physical defects of teeth, tonsils, adenoids, eyes or hearing, this large percentage probably being due to the lack of facilities for remedial correction nearer than Baltimore. Similar percentages are found in the county outside the reservation. Many of these defects have recently been corrected by the parents.

Between November 1919 and 1920 the percentage of underweight children was reduced from 42.7 to 13.8.

Mosquitoes were practically exterminated by the usual methods. This was essential, both to afford much needed relief, and to prevent malaria.

The reservation offers many facilities for research work, particularly in various phases of sanitary engineering. Its location suggests it as a school where public health administration can be taught practically to all interested.

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A HIGH GRADE WILD SKUNK

Skunk fur farming can be made a very profitable industry under proper conditions, and as a vocation it need not be at all unpleasant. In captivity or semi-domestication the unpleasant factors are eliminated. The photograph shows a high grade star male which was bred to the mutant female shown below, producing the normal wild type in Fig. 6. (Fig. 1.)

AN ALBINOTIC FEMALE

Trappers in the United States get about $3,000,000 annually for skunk skins alone, the yearly output being about 2,000,000. Skunks thus already form an important source of our native fur supply, and the fur is said to be among the very best wearing kinds. This albinotic female (mutant b) has black eyes, with brownish hair on the face. She is the mother of the litter shown in Fig. 6. (Fig. 2.)

SKUNK BREEDING

With Notes on Mutations and Their Genetic Behavior[1]

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THE fur of many species of mammals has been a source of clothing, comfort, and ornament to man since prehistoric times. Man, however, has been encroaching upon the native haunts of the fur bearers. Deforestation, draining of marshes, lax game laws, and close trapping have followed our increases in population. The result has been a marked decrease in the available fur supply. Dearborn[2] states that "in the State of Wisconsin, trappers in 1917 took over 800,000 muskrats; in 1918 they took less than 300,000; and in 1919 only about 150,000. These decreases occurred in spite of the fact that there was an increase of 10 percent each year over the previous year in the number of trapper's licenses sold." The case illustrates in a general way the situation with respect to many fur bearing mammals. When the human population was thinly scattered and economic supplies were plentiful, man could be lavish with his resources, but a rapidly growing population has changed these conditions and compelled man to use more intensive methods in the production of food and clothing.

Some efforts have been made to conserve and regulate the fur supply through fur farming. Fur farming means, in a narrow sense, breeding so-called wild animals in captivity or in a state of semi-domestication. Up to the present, most attention has been directed toward the black, blue, red, gray, and silver fox, the skunk, mink, muskrat, marten, fisher, otter, raccoon and opossum. Of these the fox, skunk, and muskrat can be farmed most profitably under the proper conditions.

THE UNITED STATES NOW IMPORTS RAW SKINS

The extent of the fur trade in the United States is not generally a matter of common knowledge. In earliest colonial times trapping and fur trading formed a most important item in the commercial history of America. For 300 years America exported raw furs to Europe, where they were dressed, dyed, and manufactured. In the last decade a decided change has taken place, for dressing, and manufacturing are now being conducted on a large scale in the United States, particularly in and near New York City, where, (as Dearborn[3] states in his pamphlet on "The Maintenance of the Fur Supply") "in 1918 there were about 60 dressing and dyeing plants, 500 dealers, 1200 manufacturers, 18,000 operatives, and an investment estimated at between $200,000,000 and $300,000,000." We are now (1919) importing annually raw skins valued at $69,000,000, while the imported dressed skins are worth only $4,000,000. This means that America is in a position to prepare and use all the skins we produce and can even import skins. One important source of our native fur supply is the musteline family, including the skunk, mink, badger, marten, sable, otter, ermine, and fisher. The U. S. Department of Agriculture states in Farmers' Bulletin 587 that skunk pelts alone bring to United States trappers about $3,000,000 annually. The annual output in skins is about 2,000,000.

[1] Paper No. 18, from the Genetics Laboratory, Illinois Agricultural Experiment Station.
[2] Dearborn, N., 1920, Circular 135, U. S. Dept. Agr.
[3] Loc. cit.

BREEDING SKUNKS FOR SIZE AND COLOR OF PELTS

Assortative matings mark the beginning of improvement in the process of domestication. In breeding skunks for fur, this truism must be as apparent as it is with our common cattle or sheep. Simple random breeding cannot supersede carefully planned matings, for such considerations as size of pelt, length, density, and texture of fur, color, and amount of spotting are indispensable to progress. Whenever man begins to improve an animal or plant, he begins with the imperfect raw material which Nature presents to him. The raw material in the case of the skunk may be any one of a number of species, subspecies or varieties of the genus *Mephitis*. One of the best wild skunks and one commonly used is the small Eastern skunk, *Mephitis pudita* Boitard. This species has a glossy, silky black coat of good texture and density, but it lacks size. Furthermore, the white stripes are not desirable, for the market demands a self-black pelt, or something as near to that as possible (see Figs. 1 and 8). The white patches must be cut out, sewed together, dyed, and sold for cheaper grades. This reduces the size of the pure black pelt and necessitates fitting smaller pieces together.

SOME PROBLEMS OF SKUNK FARMING

There are several outstanding problems in the domestication of the skunk and in skunk farming. Skunks will live in almost any part of America, but they naturally produce pelage of finest quality in the colder regions. The food problem is somewhat simplified because the skunk is omnivorous; nevertheless a skunk farm should have a cheap supply of food readily available. The item of food cost is negligible in the case of the blue or silver fox because they command sufficiently high prices; but skunks are more abundant and less valuable as individuals, therefore food cost is a significant item. Meat, meat scraps, chicken heads, stale bread, fresh table scraps, many kinds of vegetables and fruits, sweet or sour milk, mice, rats, rabbits, *et cetera* give ample material for a varied menu. In our genetic investigations we used mice discarded from other experiments, sour milk, peanuts, dried prunes, stale bread, table scraps, vegetables, or fruit occasionally, and fresh water as the staple diet.

An apparently insurmountable obstacle in skunk farming is the skunk's efficient protective response, but this need be no handicap, for a simple operation with or without anaesthetic removes the scent sacs completely without spilling or wasting any of the valuable scent. To remove the scent sacs, a horizontal slit is cut on each side of the vent, beginning about three eighths to one-half inch from the vent, in order not to injure the sphincter muscle which encircles it. The slit is made directly over the scent sac which can be located easily by palpation. Cutting down to the sac, it is then dissected from adhering muscles and raised so that the duct may be clamped with forceps or haemostat. The duct is severed and the entire sac is completely removed. No stitches are necessary, but we find that an application of iodoform to the wound is beneficial. The whole operation is of course performed under aseptic conditions. There is some market for the scent fluid. It is used to cover up traces of man by hunters who trap or hunt animals which shun man. The scent fluid is simply smeared on the boots and traps, thus quite completely disguising any odor of man and at the same time attracting the enemies of the skunk. In many cases, and under certain conditions, there is really no necessity for removing scent sacs. By careful, intelligent, and somewhat sympathetic management, one can even handle live adult unoperated skunks without misadventure or regret. The scent fluid is an oily compound, and therefore in case of mishap during the operation, strong soap and water, and gasoline will saponify and dissolve out most of the oily scent fluid which may perchance get on the hands or face. Such

CAREFULLY PLANNED MATINGS ARE NECESSARY TO SECURE FINE PELTS

This is a very high grade female skunk with a split cap. She is the daughter of the female (mutant c) shown in Fig. 5 by a very high grade male. Indispensable considerations in this sort of breeding are size of pelt, density, texture, and color of fur, and amount of spotting. Assortative mating must therefore be carefully planned for these results. (Fig. 3.)

Normal wild skunks possess two white stripes of varying extent. One of the greatest problems in skunk breeding is to produce what fashion seems to demand—solid black skins. By selective breeding the white stripes can at least be reduced in size; and a self-black mutant may occur.

faint traces as remain may be covered up and sealed by Balsam of Peru.

The existence of these scent glands and their chemically complex secretion is an astonishing and freakish play of evolution. They are also found in other members of the Mustelidae, for example, the mink. There is some histological evidence that the glands are homologous with the sweat and sebaceous glands of the skin. The secretion itself has been studied in some detail by Aldrich,[4] who found by fractional distillation that it could be divided into two approximately equal portions, the more volatile A and the less volatile B. The more volatile A can be divided again into three fractions, a, b, and c, all of which give mercaptan reactions. B gives no mercaptan reactions, but both A and B are remarkable in the large amount sulphur present. B probably contains some of the alkyl sulphides. The analysis of A shows that the fraction, a, is made up largely of one of the butyl mercaptans (C_4H_9SH) and possibly some of the higher mercaptans. The mercaptans or alkyl hydrosulphides resemble the alcohols except that sulphur replaces the oxygen of the alcohols. In general they have a repulsive garlic like odor, an odor we have often noted in disarming skunks. Aldrich made some interesting tests on the amount of secretion which may be recognized by the sense of smell and found that $\frac{1}{6,900,000,000}$ of a milligram of the fraction, a, in a cubic centimeter of air could be easily detected, and even a dilution of $\frac{1}{69,000,000,000}$ of a milligram to a cubic centimeter of air was faintly apparent to all who entered the experimental enclosure. The persistent, pervasive, and penetrating character is common to mercap-

[4] Aldrich, T. B., 1896. Jour. Expt. Med., Vol. 1, pp. 323–340.

A PURE ALBINO FEMALE (MUTANT A)

White skins are in demand for children's furs, and breeding pure white skunks is not an impossibility. The photograph above was taken from a mounted specimen in possession of the Skunk Development Bureau. (Fig 4)

tans other than the butyl found in the skunk. These trials are only another proof of the extremely sensitive testing apparatus we have in the olfactory sense—far more delicate than the spectroscope, as Aldrich states.

MARKET DEMANDS SOLID BLACK SKINS

There are also genetic problems of much importance and of more difficulty than the problems of simple management. The normal wild skunk shows two white stripes of varying extent, but the fashion demands a solid black or something as near that as possible. There is no doubt but that selective breeding can reduce the proportions of this white pattern, and give races with at least only a small patch of white on the crown of the head—the so-called star black. A high grade star male in our experiment was mated to an albino whose pattern factors were of course unknown. The offspring were of the very high grade (see Fig. 7) like the sire. One of these showed a split star in which only a small patch on each side of the head remained. This is the highest grade individual we have ever seen (Fig. 3). We know of no imperative or inherent reason why a mutation to self-black should not occur, in which the factor (or factors?) for white stripes would be eliminated. Such a form should then breed true to self-black and thus solve one of the most perplexing problems of skunk breeding. We have received records of such forms but none have been tested genetically to our knowledge.

ALBINOTIC FEMALE, MOTHER OF THE LITTER SHOWN IN FIG. 7.

This female (mutant c) was captured about five miles from the region where the one in Fig. 2 was found. It has pink eyes with a narrow line of pigment around the inner and outer margins of the iris. Mated to a wild male it produced the litter shown in Fig. 7. (Fig. 5.)

Mutations giving other desirable shades and colors of skunk fur are probably just as possible in this group as they are in the fox. If, for example, a blue or silver mutation should occur in the skunk family, it would undoubtedly have considerable value, possibly great value. White seems to be in demand for children's furs, and a pure white variety of skunks is not an impossibility as we shall show. It is safe to say that rich seal brown without stripes, pure white, self black, silvered, and blue fur of excellent quality will always be in demand. Some of these forms have been produced in the skunk; probably all are possibilities. It s however difficult to say which of these forms would be the most valuable, since, of all mutations, that of woman's fancy in attire is the least predictable.

RECORDS ON MUTATIONS

The junior writer has been studying the general problem of skunk breeding since 1894. Since 1914 the senior and junior writers have been gathering records on mutations and have made such genetic tests as were possible with available materials, in order to throw some light on special breeding problems connected with the domestication or semi-domestication of this fur bearer. The following represents our complete record of mutations up to the present time:

Mephitis pudita

a. Female; fur white, eyes pink, skin pink on nose, eyelids, ears and feet. Captured by James Clark and L. P. Jarrett in Addison Township, Oakland County, Mich., Nov. 16, 1913. Taken from den of six, the rest of which were normally pigmented. Purchased April 24, 1914, died May 17, 1914, and mounted by taxidermist. See Fig. 4.
b. Female; fur white on body with some light brown hair on face and extremities; eyes black. Captured about 25 miles from Schwenkville, Penn., November 1914 by J. M. Bray. Purchased for experimental breeding Feb. 10, 1915. Fig. 2.

c. Female; fur white, eyes pink with distinct narrow pencil line of pigment around the inner and outer margins of the iris. The skin on the nose, eyelids and soles of the feet was pink. Captured about 5 miles from region where mutant b was found. Purchased from same source and at same time as mutant b. Fig. 5.

d. Female; fur white, eyes pink. The skin on the nose, eyelids, and soles of the feet was pink. Reported to us on March 4, 1916 by L. P. Jarrett, Oxford, Mich., as being captured in vicinity. Purchased for experimental breeding.

e. Unknown sex; fur white, eyes pink. Reported to us for sale by owner, J. S. Daigneault of "Le Renard Noir, Limité," Marieville, Quebec, on Feb. 2, 1915.

f. Male; fur white, eyes pink. Reported to us for sale by C. C. Garland, President of Garland Zoological Co., Oldtown, Me., on January 28, 1918.

g. Male; fur white, eyes pink. The skin on the nose, eyelids, and soles of the feet was pink. Sold to us by L. P. Jarrett of Oxford, Mich., January 1, 1918. Captured by a trapper in same general region as mutants a and d.

h, i, and j. Male and two females; seal brown fur, pigmented eyes. Striping similar to normal skunk. Reported to us for sale by J. M. Bray, Schwenkville, Pa., Feb. 17, 1915. Hair samples from these were obtained. These mutants were caught 10 to 15 miles apart in Chester and Montgomery counties, Penna.

k and l. Unknown sex; two all black individuals obtained by J. M. Bray, Schwenkville, Pa., and reported to us for sale on February 17, 1915.

Mephitis hudsonica

m. Male; fur white, eyes pink. Captured in Fargo, North Dakota, and sold to us Nov. 20, 1915.

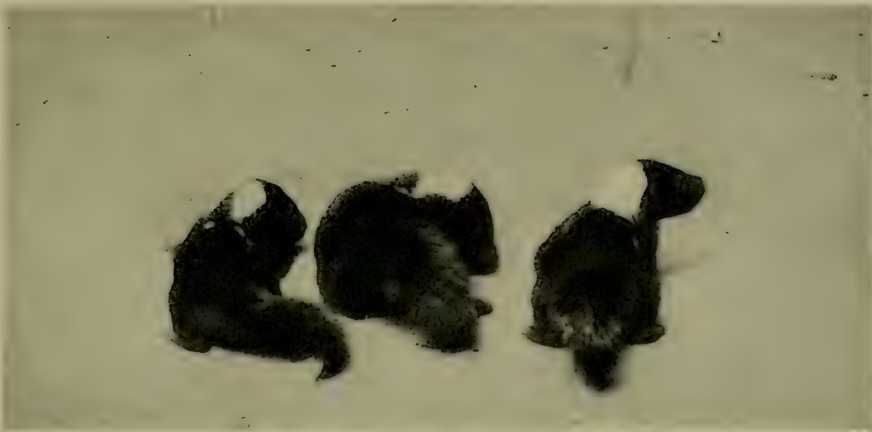
n, and o. Male and female; fur seal brown, eyes pigmented, striping normal. Reported to us by L. F. Brash, Newark, South Dakota, for sale July 19, 1916. Hair samples received.

Summarizing, we may say that twelve mutations have been discovered in *M. pudita* and three in *M. hudsonica*. Mutations are evidently fairly frequent in this genus. All of the so-called mutants may not be original mutants, but simple segregates cropping out after the original mutant (probably a heterozygous mutant) had been breeding in a given vicinity. For example, several mutants, (a, d, and g) of the pure albinic type were reported from the region of, Oxford, Michigan. The mutations are not restricted to one general region for we find them in Pennsylvania, Maine, Michigan, North and South Dakota, and Quebec. There were five distinct types of mutation:

1. self-black; mutants k and l.
2. seal brown with white stripes; mutants h, i, j, n and o.
3. black eyed white; mutant b.
4. white with a small amount of pigment in eyes; mutant c.
5. pure albino; mutants a, d, e, f, g and m.

Some of these mutants have been described previously (Detlefsen '16).[5] All of these cases of mutations are unquestioned, since the data are based upon animals we have either seen or purchased, or upon descriptions (with hair samples when possible) from reliable sources, dealers or trappers with whom the junior writer has carried on extensive business transactions for years. We have several other records, some from reliable sources but with very meagre descriptions, and some from less trustworthy sources. For example we have a record of a yellow type, but cannot determine whether it is really yellow, or cream, or simply a discolored white. Whenever pecuniary inducements are offered, it seems to stimulate the hunt for mutations; in fact we were inclined to believe at one time it hastened their

[5] Detlefsen, J. A., 1917. Anat. Rec., Vol. 11, No. 6, p. 502.



FIRST GENERATION OFFSPRING FROM PARENTS SHOWN IN FIGURES 1 AND 2

This litter is the result of a mating of the high grade wild star male shown in Fig. 1 with the mutant female shown in Fig. 2. All three-one male and two females—possess rather high grade color markings. One female died before maturity; the other two of the litter were mated during the following year and produced a litter of seven females—six black and one white. The mother killed her young but important data had been secured relative to the genetic variations. (Fig. 6.)

A LITTER OF EXTREMELY HIGH GRADE YOUNG SKUNKS

The white female (mutant c) shown in Fig. 5 is the mother of this litter. The other parent was a very high grade wild male. Note the extreme high grades in the offspring. "Such a uniformly high grade litter from a high grade male by a female of unknown pattern factors, probably indicates the germinal nature of the variations in pattern and gives some assurance of producing a high grade race through selection." The white animal in this picture is the mounted specimen shown in Fig. 4. (Fig. 7.)

occurrence. We once received a self-black, but the first rainstorm proved that the so-called "sport" was not fast black, either somatically or genetically. It was promptly returned. Therefore in listing these mutations we have carefully eliminated all questionable cases.

Breeding investigations were begun in 1914 with such mutants as could be purchased, and on as large a scale as funds and space would allow. The earlier matings were made by the Skunk Development Bureau, near Chicago, but in 1916, it became necessary to move the stock on hand to the Illinois Agricultural Experiment Station. This move hampered our experiments because the animals needed much more room and less disturbance for their proper care. They were housed in dens in a small yard about 10 feet wide and 30 feet long. The dens and cages were of the type described by Holbrook in 1915.[6]

The first mutant, *a*, typical albino female with pink eyes, failed to breed and died soon after her arrival, due to her poor condition.

Mutant female, *b* (white fur with brownish hair on her face and extremities, and black eyes), was successfully mated to a high grade wild star black male on March 4, 1915 and produced three black young of rather high grade striping on or about May 11. The period of gestation is thus about 65 days or less. The young (see Fig. 6) were:

♀ 1. }
♂ 2. } these were wild black, with very short white stripes. ♂1 and ♀2 bred together gave an F_2 generation.
♀ 2a. died before maturity.

Fortunately ♀1 and ♂2 were successfully bred during the next spring in 1916 and gave a litter of seven F_2 young as follows:

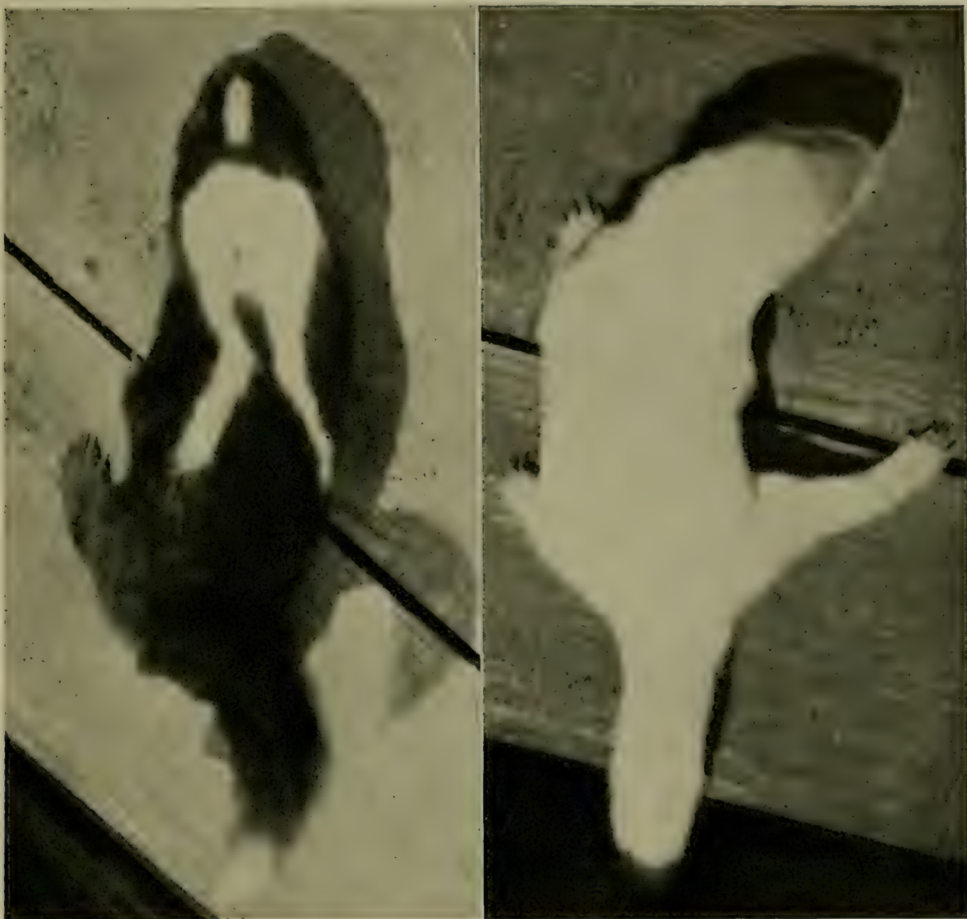
♀14 }
♀15 }
♀16 }
♀17 } These young were wild black with variable amounts of white striping.
♀18 }
♀19 }

♀20 white, with black eyes like grand-dam, ♀ mutant b.

The dam (♀1) killed her young but sufficient data were secured to demonstrate that mutant *b* was a real discontinuous and genetic variation, rather than a wide fluctuation. The amount of white in the striped pattern of skunks varies so much that a black-eyed white might seem to represent an extreme in the spotting series, similar to the black-eyed white guinea-pig. There can be no doubt as to the simple Mendelian nature of this germinal change. The white F_2 (♀20) had pigmented eyes exactly like her grand-dam, mutant ♀b. The rest of the litter was normal black with variable amounts of striping. No further investigation was possible with this mutation, for the original mutant *b* was old when captured and produced no more young, and the F_1 generation failed to breed again. This type of mutation is evidently a Mendelian recessive, and a pure race should not be difficult to obtain. It would not be as valuable however as a race from mutants *c* or *g* which were pure white.

Mutant *c*, an albino female with a very fine pencil line of pigment around the inner and outer margins of the iris, was mated successfully in 1915 and again in 1917. The first mating was made to a very high grade star-black male on March 4, 1915 (male removed April 18) and seven extremely high grade young were born on or about May 9, 1915. Such a uniformly high grade litter (see Fig. 7) from a high grade male by a female of unknown pattern factors, probably indicates the germinal nature of the variations in pattern and gives some assurance of producing a high grade race through selection. One female (see Fig. 3) was remarkable in that she showed as an adult only two small patches of white over the ears, (each patch covering less than two square centimeters), and very few white hairs at the tip of the tail. Our records point again to a gestation period of 65 days or less. We are not certain that the young were not born a few days before May 9, for

[6] Holbrook, F. M., 1915. Skunk Culture for Profit, pp. 1–142, ill. Publ. by Skunk Development Bureau, White Plains, N. Y.



SEGREGATION OF COLORS IN THE SECOND GENERATION

A white male (mutant g), apparently a true albino, was mated with a normal wild black female possessing the usual stripes, and produced six normal wild striped black young. This type of mutation therefore was shown to be recessive to the wild character. The following year two of these young were mated and produced a litter of five young, four black and one white. This white with one of the black ones is shown above. They present a case of simple Mendelism. (Fig. 8.)

extreme precautions had to be used, since the mother was likely to kill her young litter, if prematurely disturbed. The F_1 young were as follows:

♀3, ♀3a, ♀3b, ♀3c, ♀3d, ♂3e, ♂3f — All these F_1 young were black with split star, and white tip on tail. Two of them had a small narrow nose spot.

Mutant ♀c gave no young in 1916; she may have aborted or eaten the young. Mated to a medium grade male in 1917 she gave a litter of four young of medium grade in the spring as follows:

♀4, ♀5, ♀6, ♂7 — All these F_1 young were black of a medium grade—i.e., with white cap and short stripes.

The total eleven normal wild F_1 offspring demonstrated quite conclusively that this mutation is recessive to the wild from which it arose.

Of these F_1 offspring, ♂7 was successfully mated three times giving two litters by ♀6 in the spring of 1918 and 1919 and one by ♀5 in the spring of 1919 as follows:

♂7 x ♀6 — ♂8, ♂9, ♀10 — normal wild black with variable striping.

♂7 x ♀6 *Continued*	♀11 ♂12 ♀13	white with rim of pigment on inner and outer margins of iris like mutant ♀c.
♂7 x ♀6	♀31 ♂32	normal black wild with white V on head.
♂7 x ♀5	♀33	white, similar to ♀11 above.
	♀34 ♂35 ♀36	normal black wild with variable striping.

Total F_2; 8 black wild: 4 albinotic

The ratio of 8 : 4 is of course well within reasonable limits of error when tested against the theoretical Mendelian ratio of 9 : 3. This type of mutation exhibited by the original mutant ♀c is therefore quite evidently a simple Mendelian recessive. The F_2 recessive segregates were of exactly the same type as their granddam, even to the minute detail of carrying a small rim of pigment around the inner and outer margins of the iris. It was not possible to carry the descendants of this mutant any further. Close quarters, distemper, cannibalism, and the effects of close inbreeding to which our skunks seemed very sensitive, put a decisive end to this line of breeding. In fact we were fortunate to get sufficient data to demonstrate the Mendelian nature of the mutation. The young in several litters had to be raised under arduous and harassing conditions; e.g., when a dam died just after parturition, we saved the young through the expeditious, artificial feeding of cow's milk by making a nipple from the inner tube of a self-filling fountain pen,—an event probably historic in the annals of skunk breeding! In any event, the artifice was successful, and our records show that the young lived well through weaning time, and were carefully examined, classified and disarmed, only to die of distemper before we could breed them.

The last type of mutant which we subjected to breeding tests was mutant ♂g—apparently a true albino. He was captured in the same region as his exact duplicates, mutant females *a* and *d*. The latter two died before we could obtain any young and in spite of all efforts and devices at our command. Male *g* was bred to a normal wild black female with the usual dorsal stripes, (♀43) and produced six F_1 normal, wild, striped black young in the late spring of 1919 as follows:

♀37 ♀38 ♂39 ♀40 ♂41 ♀42	All F_1 young normal wild black, with short stripes.

This type of mutation was therefore recessive to the wild. Of these F_1 individuals, ♂39 and ♀37 were successfully mated giving an F_2 litter in May, 1920, in which the recessive segregates appeared, as follows:

♂44 ♂44 ♀46 ♀47	These F_2 young were wild black with the usual short stripes. See Fig. 8.
♂48	pure white with pink eyes like mutant ♂g.

The case of the pure albino mutant ♂g resembles that of the other albinotic forms we tested, in that the germinal change apparently involves only a single gene and therefore gives a case of simple Mendelism.

While these experiments indicate that each one of these three albinotic mutations is a simple Mendelian recessive to the wild type from which it arose, they do not show the relation of one to the other. They may be multiple allelomorphs representing various conditions of a single gene, or they may be the entirely independent mutations of different genes. A breeding test would easily settle this point. If, on the one hand, they are multiple allelomorphs like the various conditions of the color gene in the guinea-pig, rat, or mouse, or like the numerous conditions of the gene for red-eye in Drosophila melanogaster, there would be a scale of dominance in which the three mutations would lie and no two mated together would produce a reversion to the wild type. It has seemed to us, a

priori, that this view of the relation between the mutant genes was the more logical because the color gene in experimental rodents has shown a greater mutability than any other gene. If, on the other hand, they represent mutations in different genes, either linked or independent, then a mating between two different mutations would give the wild type, exactly like the case of the pink-eyed yellow rat mated to the dark red-eyed yellow rat. We had hoped to mate ♂g (pure albino) with ♀c, (almost complete albino) or at least to mate these two types of mutant together as they appeared in subsequent segregating generations, in order to settle this question, but the opportunity was lacking. However, we found it possible to make two matings which, while not ideal, threw some light on the problem. Females 4 and 5 were mated to male mutant *g*, each female giving one litter in the spring of 1918. Now ♀4 and ♀5 were F_1 offspring from a cross between ♀c (white with pink eyes and a small rim of pigment around the inner and outer margins of the iris) and a wild type male. If this mutation is a condition of the wild color factor *C*, then we may represent it by C^1, and ♀♀4 and 5 would have the genetic constitution CC^1. It follows that if ♂g (pure albinic type) is also a member of the triple allelomorphic series, we may assign to him the formula *cc*, where *c* stands for either a complete loss of the color factor *C*, or at least a lower grade or level of this factor than C^1. A mating of mutant ♂g to either ♀4 or ♀5 would then be in Mendelian terminology as follows:

♀4 x ♂g = CC^1 x cc

$C + C^1$ = gametes of ♀4

c + c = " " ♂g

$Cc + C^1c$ = zygotes of hybrids

Our previous matings (animals No. 37 to No. 48 on p. 252) have shown that *Cc* is wild type. C^1c would be an individual heterozygous for complete albinism, *c*, and the very low grade of color, C^1; and it should be in all probability albinotic like C^1, (white with little pigment in the iris). These two forms should occur in equal numbers. However our experimental results, as far as they go are not in accord with such a hypothesis, for the matings of ♂g to ♀♀4 and 5 gave nine wild black young as follows:

♂g x ♀4 ♂21, ♀22, ♀23; ♂g x ♀5 ♀24, ♀25, ♀26, ♀27, ♂28, ♀29 — All of these young were wild type, i.e., black with short stripes

In other words, we observed nine wild type when our hypothesis calls for equal numbers of the wild type and the albinotic. Such an event is not absolutely impossible even if our hypothesis is correct, but it is decidedly improbable. It should occur only once in every 512 litters of nine. Stated differently, we should expect *at least* one albinotic individual in a litter of nine, in 511 out of every 512 such litters, or in 99.8% of such cases (obviously the first $n-r+1$ terms of $(p+q)^n$ where $p=q=\frac{1}{2}$, n=size of litter=9, and $r=1$ or the single albinotic individual which is necessary to prove, and which by its very occurrence would prove the correctness of our hypothesis). All that we can say under these conditions is that this hypothesis may be correct, but the evidence does not point that way. Therefore these two types may be mutations in different genes.

Two other albinos were in our possession for some time, but gave no progeny. Female mutant *d*, a pure typical albino with pink eyes, was kept with a vigorous male during at least two breeding seasons but failed to give young. Male mutant, *m*, also a pure albino with pink eyes but belonging to the larger species M. hudsonica was kept with several females of the species M. pudita during one breeding season. Although the animals of these two species lived together peacefully, no young were produced. We are not

certain that the two species mate, but it is barely possible that the species cross is unproductive.

We can hardly pass over our records without commenting upon the great preponderance of females observed in our experiments. Out of a total of 53 individuals born in our pedigreed cultures, 16 were males while 37 were females. If the males and females are equally probable, in accordance with our usual present concept, then 26.5 of each sex is the most probable expectation. The deviation of 10.5 in our observed records from the theoretical is 4.28 × the probable error of simple sampling, 2.455. The odds against deviations of this and greater magnitudes are about 250 to 1. The observed ratio is therefore not impossible on the basis of a theory which calls for an equal number of the males and females, but raises a legitimate suspicion that the zygotes classified at birth may be the residue left after considerable prenatal selection and elimination. After all, the theory is meant to apply only in a strict sense to zygotes formed, rather than to zygotes classified.

Summarizing, we may say that we have found fifteen mutant skunks, which fall into five types. The three different albinotic types represent simple changes in single genes and therefore each gives a monohybrid ratio when crossed to the wild form. There is no evidence that they may be multiple allelomorphs. In fact, the two more extreme forms of albinism give some evidence to the contrary. Our records showed a great preponderance of females over males.

Mutations are relatively abundant in the genus *Mephitis*. The occurrence of self black, or blue, or silver types is probably only a matter of time and opportunity to observe large numbers. When such occur, they can be perpetuated without much doubt, in the same manner we used to increase the number of whites. A knowledge of simple Mendelism would suffice for such cases. Since our skunks seemed to be so susceptible to the effects of inbreeding, we would modify our procedure in the following way:—by breeding unrelated F_1 hybrids from similar mutants or by breeding F_1 half brothers and sisters from a single mutant to obtain more vigorous segregates in the F_2. At least we should try this method to see if it might not perhaps have some advantages over the usual mating of F_1 sibs together.

Selection for the reduction of white or for increased size would be effective we believe, but we would resort to mass selection, in order to avoid close breeding. One might perhaps find strains which are not so sensitive to inbreeding as our skunks proved to be, in which case one could select more rigidly. If some species crosses are found to be possible, increased size might be secured in that way by the usual hybridization methods.

American Association for the Advancement of Science

Meeting in Toronto, December 27–31, 1921

The 74th meeting of the A.A.A.S. and affiliated societies is being held this year in Toronto, Canada by invitation of the University of Canada and the Royal Canadian Institute. While this is not one of the larger, four-yearly meetings of the Society and therefore will not be so complex as the one held in Chicago last year, it is expected to be of exceptional interest on account of its international character. Scientific workers from the two English-speaking nations will have opportunities for strengthening the bonds of mutual understanding and of personal and national friendship. Several British scientists may also be present to address the sessions. Many members of the American Genetic Association will be in attendance and present papers.

REARING MEAL MOTHS AND PARASITIC WASPS FOR EXPERIMENTAL PURPOSES

P. W. Whiting
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For a number of years the writer has been engaged in rearing insects for genetic experiments. The Mediterranean flour-moth, *Ephestia kühniella* Zeller, and its parasite, *Hadrobracon brevicornis* (Wesmael), have been found good material for the purpose in view.

There have recently been received a number of requests for information as to technique of rearing these insects and it has therefore been thought advisable to publish an account of methods for the benefit of those who may care to use them in their laboratories.

Washburn (1904, The Mediterranean Flour Moth. Special Report of the State Entomologist of Minnesota) has given an account of the moth—its habits, its history, the methods for its control, etc., and the writer (1919, Jour. of Exp. Zool. Vol. 28, No. 3) has reported on some preliminary genetic experiments.

The insect varies from three-fifths of an inch to one inch in total expanse of wings which are dull gray marked with zigzag lines. There seem to be no apparent secondary sexual characters, but sexes may readily be distinguished by external genitalia. The larvae are about five-eighths of an inch in length when full grown. Testes are reddish, showing through the creamy white body and affording a ready method for identifying sex in this stage.

METHODS OF REARING THE INSECTS

The writer's earlier work was much hampered by technical difficulties. It was found that, while the insect bred well in mass cultures, the percentage of individual pairs producing offspring was very low. Experiments were performed with different degrees of temperature and humidity as well as with various kinds of food. A series of tests conducted at the Zoological Laboratory of the University of Pennsylvania showed that many females refused to oviposit and died with abdomens filled with eggs apparently normal. Moreover many eggs that were laid failed to hatch even though the female had mated. The causes of these difficulties were never discovered. Success in rearing the moths was finally attained, however, with rolled wheat (Pettijohn's Breakfast Food). This appears to furnish the optimum stimulation to oviposition and the larvae feed well upon it and grow large and fat if ample floor space is provided in breeding tins.

MALE WASPS FEEDING FROM A DROP OF HONEY DILUTED WITH WATER (X8)
Photo by Doten (Figs. 9 and 10.)

THE INSECTS ARE STUDIED WITH A BINOCULAR

Adults of moths or wasps are etherized for examination. If it is desired to study the ovipositing wasps or to count their eggs the paralyzed caterpillars are placed upon a piece of glass which is set about three-quarters of an inch above a mirror. By focusing either upon the insects directly or upon the image, upper or lower sides may be observed at will. (Fig. 11.)

For individual matings freshly emerged pairs are set in tin boxes with tightly fitting covers. A type of cylindrical slip cover can, made by Mason Manufacturing Co., Providence, R. I., having a diameter of seven and one-half inches and depth of four inches has been found to be of convenient size and satisfactory for the purpose. The can, containing a little cereal and the isolated pair, is set away on a shelf. No food for the adults is necessary. A warm temperature, 27° to 30° C., gives best results, but humidity must be fairly high or young larvae will not develop. During the winter, in presence of artificial heat, it is often necessary to place dishes of water in cupboard where tins are set.

Contamination of the culture is prevented by toasting or autoclaving the cereal and by placing a little vaseline in the crevice formed by the seam at the cover. Beetles, mites, bacterial and protozoan diseases may otherwise be introduced, as well as undesired caterpillars or moth eggs.

The moths scatter their eggs over the cereal and these hatch in approximately a week, the time varying according to temperature. The young larvae spin webs attaching particles of cereal together. After two or three weeks, an inspection should reveal webbiness of the cereal, denoting successful pairing and fertility. More cereal should then be added and the box set away again. If temperature is high larvae will attain full size in four weeks from time of isolating the parental pair. Pupae are then formed in silken tubes. The entire period from egg laying to eclosion may be reduced to five weeks, but usually six weeks are required for a generation in summer weather. Eclosions begin at the end of this time and moths will continue to emerge for three or four weeks or longer if culture is crowded when there will be many laggards.

There seems to be a diurnal cycle of some sort in eclosion. Many more moths emerge in the latter part of the afternoon and in the evening than during the rest of the day. It is therefore advisable to be on the watch at this time if virgin females are desired for mating. Copulation takes place as soon as wings are dry, so that the virginity of any female is never certain unless wings are soft or unless there are no males present.

THE FEMALE WASPS STING THE CATERPILLAR AND FEED AT THE PUNCTURE

The males do not get any of their nutriment in this way and if kept in a jar must be fed on a mixture of honey and water. After stinging the caterpillar and the latter has become torpid or dormant, the female wasp deposits her eggs. (Fig. 12.)

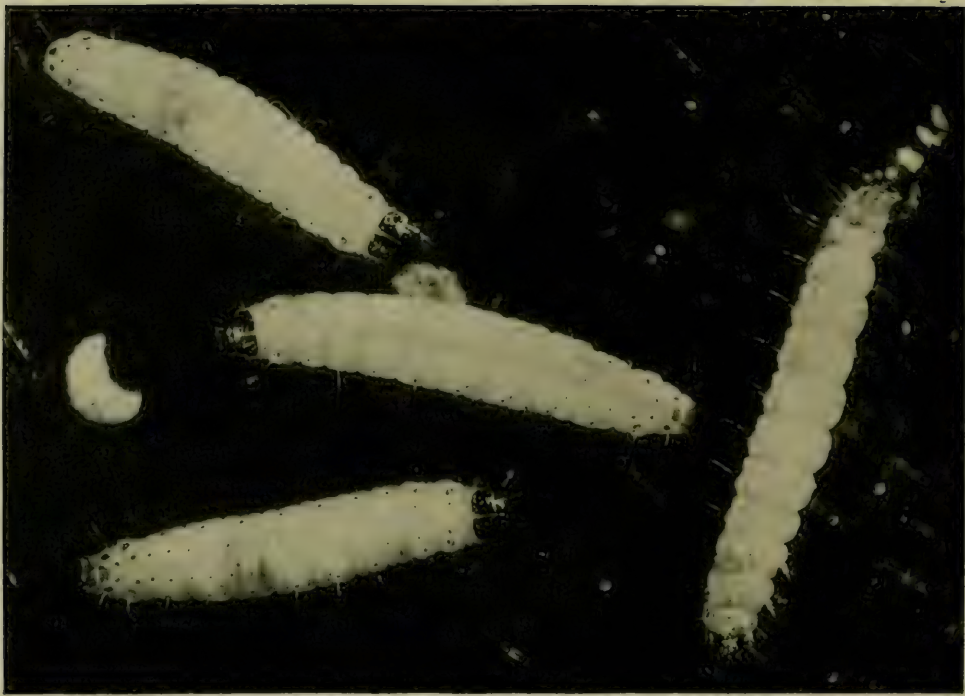
ANOTHER VIEW OF STINGING WASP

The sexes are readily distinguished by the longer antennae of the male and the ovipositor of the female. Compare Figs. 9 and 10 with these two views (Fig. 13.)

COLLECTING THE MOTHS

Moths rest on cover, sides of tin or on the cereal and may be conveniently collected in a shell vial. This is placed over each one and at the same time the culture tin or cover is tipped in such a way that the insect will fall down into the vial when touched by it. If many moths have emerged and are disturbingly active, the tin may be cooled slightly to quiet them. Several individuals may be collected successively in the vial which is then inverted into an etherizing bottle as in work with Drosophila. A few seconds only are necessary to quiet the moths which may afterwards be placed upon a card and examined. Anaesthesia occurs much more quickly than in Drosophila, but the moths recover without injury after a short exposure. Two wide-mouthed bottles are used, the cork with cotton suspended on a wire and saturated with ether being transferred from one to another. Soft, smooth-tipped "butterfly tweezers" such as are made by Denton Brothers, Wellesley, Mass., are convenient for handling the insects which should be collected once a day if wing markings are to be studied as scales are likely to be rubbed off after a longer time.

If it is desired to keep a stock of Ephestia conveniently isolated for future work, the culture may be set in a cold place. Even at rather low room temperature the insects may safely be left undisturbed for several months, especially if white flour be added. The finer material packs down closely preventing its rapid utilization by the larvae. A culture was set in a glass jar, four inches in diameter and five inches high, half filled with white flour. A tin cover was screwed down tightly and the material placed in a moderately cool room. After eighteen months an examination showed insects in all stages of development and the flour by no means exhausted.



PARALYZED CATERPILLARS AND FULL GROWN MAGGOT

Caterpillars, after they have been stung by wasps, become torpid, but the heart continues to beat even though they have lost ability to move. The dark line in the region near the middle of the back in the caterpillars is the heart. It may be seen faintly in the photograph. Dark red testes situated just back of the middle of the body distinguish the males. (about x5) (Fig. 14.)

A PARALYZED CATERPILLAR AND WASP EGGS

The illustration at the left is a mirror image of the under side of a paralyzed caterpillar. Eggs of the parasitic wasp *Hadrobracon brevicornis* may be counted in normal position between caterpillar and glass. In the picture at the right, the caterpillar has been rolled over and the wasp eggs photographed directly. (x4). (Figs. 15 and 16.)

The caterpillars feed not only upon various cereals, but are carnivorous as well. On one occasion a number of moths were killed and mounted for reference. A few eggs which had been extruded at death, adhered to the bodies. Larvae hatched, devoured their parents, spun webs and formed pupae.

WASPS AS MATERIAL FOR GENETIC EXPERIMENTS

The parasitic wasp, *Hadrobracon brevicornis* (Wesmael), has proved to be excellent material for genetic work, and should be of value for other experimental purposes as well. The insect resembles Drosophila in size and in the duration of its life. It may be conveniently reared in shell vials, 20 mm. x 70 mm. For continuous work a constant supply of full grown Ephestia larvae is necessary; but should the food supply fail, the wasps may be set away in the ice chest or even at freezing temperatures and kept for months. Mass

GREEDY MAGGOTS SUCK THE JUICES OF THE CATERPILLAR

"Maggot-like larvae emerge very shortly from the eggs (which have been deposited in the caterpillar by the female parasitic wasps) and cling to the integument of their host. Growth is rapid and soon white cocoons are spun." (about x7) (Fig. 17.)

cultures of moths are made in the tin boxes described above. If the young caterpillars appear crowded, masses of the cereal matted with webs are removed and divided into other boxes containing cereal. When the caterpillars attain full size they are collected with tweezers. Disturbing the cereal will cause the larvae to crawl about exposing themselves. They will finally come to rest upon the cover from which they may be easily collected. Four or five fat caterpillars are placed in each vial which is closed with a tight cotton plug wrapped with cheesecloth through which neither caterpillars nor wasps will burrow. During earlier experiments corks were used but it was found that the wasps gnawed their way through these.

In the wasps the sexes may be readily separated by observing the longer antennae of the male and the prominent sting and sensory gonapophyses of the female.

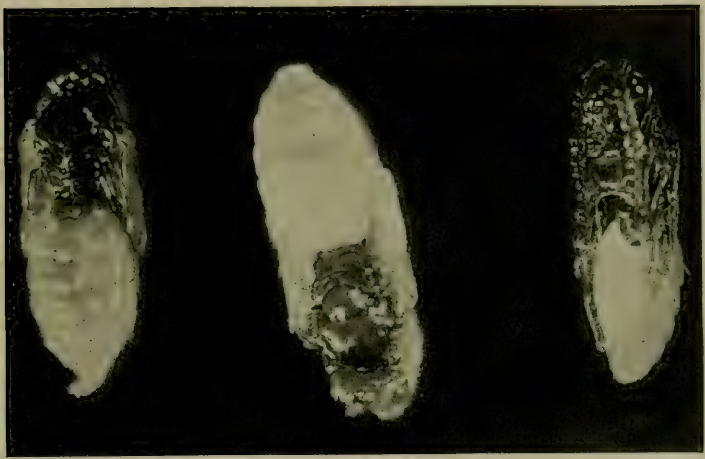
The female is placed in the vial with the caterpillars and the culture set in a warm place. Optimum temperature for development is 30° C. at which the period from egg to eclosion is about

THE SHRIVELLED CATERPILLARS ARE ABANDONED BY THE FULL GROWN MAGGOTS

By the time the maggots become full grown the caterpillars are reduced to shrivelled remnants. The maggots then spin white silken cocoons in which they pupate. Note also the illustration below which shows a cocoon farther advanced in growth and the caterpillar more shrivelled. (x4½) (Fig. 18.)

VIEW OF COCOON AND SHRIVELLED CATERPILLAR (Fig. 19)

ten days. The wasps do well under conditions considerably more arid than the moths can endure. Doten (1911, Agricultural Experiment Station, The University of Nevada. Technical Bulletin No. 78) states that Hadrobracon is able to survive lack of moisture better than any other Hymenopter with which he experimented. The females sting the caterpillars and suck juice from the puncture. Males obtain no nutriment in this way and will live only a few days at room temperature unless they be fed. Either males or females may be kept alive in shell vials for extended periods by feeding on a mixture of honey and water. It has been found convenient when a few insects are being kept for mating purposes, to have a small bottle of honey and a little water in a separate container, for if the two be mixed fermentation occurs. A metal rod such as a fine knitting needle is dipped into the honey, then into the water and touched to the inside of the vial where the drop will adhere. If the insect be hungry



THE PUPAE APPEAR LIKE MINUTE WAXEN IMAGES

And they may be separated as regards sex and eye color. The photograph shows in order: the dorsal view of a black eyed female with ovipositor visible (the appendage at the bottom); dorsal view of an orange eyed male; and ventral view of a black eyed male showing the characteristic male antennae. The orange eye color is a Mendelizing difference from the black. (about x17) (Fig. 20.)

it will come to rest at the drop from which it engorges itself. At ordinary room temperatures it is necessary to feed the wasps every other day, but if it is desired to keep any individuals isolated for an extended period it is better to feed them once and set them in the ice chest.

OBSERVE COCOONS CAREFULLY

At eclosion both males and females are either mature sexually or almost so, consequently females are certainly virgin only if males are not present. In obtaining virgin females, pupae should be isolated or great care should be taken to see that no mature wasps are present in the culture. The insects have the habit of crawling back into cocoons after eclosion. For this reason it is important to see that cocoons are either empty or intact.

After stinging the caterpillar the female deposits no eggs until her victim has become torpid. Eggs are placed on top of the caterpillar or underneath and may be easily observed. There is no danger of contamination from the food (even if wasps have infested the caterpillar culture) for eggs are never laid except upon torpid and flaccid hosts. Such should of course be discarded in selecting caterpillars for the culture vials.

Maggot-like larvae emerge very shortly from the eggs and cling to the integument of their host. Growth is rapid and soon white cocoons are spun, attached firmly to the glass. The caterpillars are reduced to shrivelled remnants which are often shaken into the etherizing bottle with the first count of wasps. Hadrobracon is much more resistant to ether than is Drosophila and very much more resistant than Ephestia. It is usually safe to let one lot of wasps remain in the etherizing bottle while another lot is being counted.

If males only are desired they may be obtained parthenogenetically from virgin females. Mated females produce both males and females.

HEREDITY IN WASPS

A Study of Heredity in a Parthenogenetic Insect, the Parasitic Wasp, Hadrobracon

P. W. Whiting

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SEVERAL varieties of honey bees differing in color, habits, and temperament have been developed by apiarists. Crosses of these have given results of much interest both to bee breeders and to students of genetics and cytology. As is well known the honey bee flies high in the air while mating and consequently experimental work with this form is seriously handicapped. Drones are supposed to arise from unfertilized eggs and are haploid having the reduced chromosome number. Workers and queens are the female forms, the former with ovaries undeveloped due to a difference in feeding. Females are diploid and presumably arise from fertilized eggs. This principle of sex determination as applied to the bee is known as Dzierzon's Law. According to this principle drones should always resemble the maternal race while workers and queens should be hybrid, either resembling the dominant form or, in case of lack of dominance, being intermediate. Results of breeding tests have been conflicting. Newell crossing Italian and Carniolan races obtained offspring according to expectation, while earlier investigators with German and Italian strains found a variable number of more or less "patroclinous" drones, that is drones resembling the male parent.

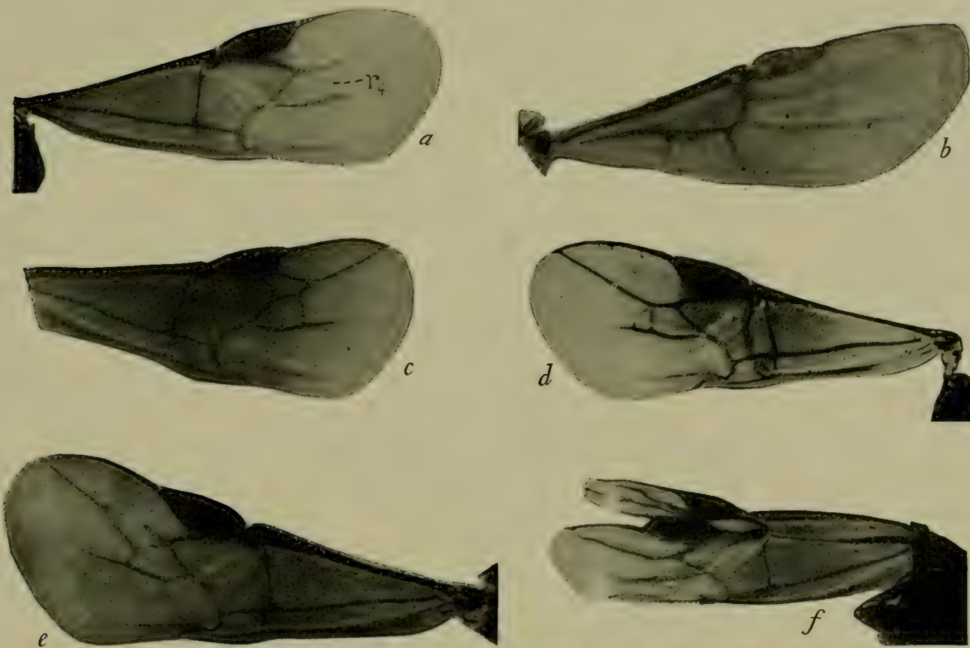
Mendelian heredity complicated by parthenogenesis has been shown by Nabours in a grouse locust, Apotettix, and by Fryer in a Phasmid, but the bee is the only form in which hereditary differences other than sex have been studied in connection with haploid parthenogenesis. If parthenogenesis is haploid, the gametic series should be given directly in the progeny from a virgin female, in other words there should be no complications due to fertilization. This is inheritance according to Dzierzon's Law and is of a "criss-cross" type resembling sex-linkage superficially. It differs from the latter, however, since males arise from unfertilized eggs and the sex ratio is consequently extremely variable. This method of inheritance may be called sex-linkoid.

Sex-linkoid inheritance should occur in bees, wasps, and ants, as well as in many of the lower Hymenoptera, white-flies, thrips etc. Several parasitic wasps, however, produce females parthenogenetically and in this case we may expect segregation if the reductional division of the egg nucleus is not omitted. In the gall-wasps alternation of parthenogenetic and sexual generations should show complicated types of inheritance. Aphids should also furnish material of much interest if Mendelizing characters were studied.

The writer has for some time been working with a wasp, *Hadrobracon brevicornis* (Wesmael), parasitic upon the caterpillars of the Mediterranean flour moth. The insect is easily manipulated and passes through a generation in ten days in the incubator. Three hundred and fifty or four hundred offspring are often produced from a single female. Parthenogenesis is strictly haploid or "male-producing." Thousands of offspring reared from virgin females include not a single female.

WIDE COLOR VARIATIONS

The insect's extreme variability in color and size has caused much confusion in taxonomy. The color ranges from honey-yellow to black, the darker pigment being distributed in areas of varying size. This variation appears to be due almost wholly to temperature, selection having no effect. Higher temperatures produce relatively more



WINGS OF WASPS SHOWING HEREDITARY VENATION

The parasitic wasp *Hadrobracon brevicornis* furnishes excellent material for studies in heredity. There has been found a variation in the venation of the wings, and the character has proved to be hereditary and also correlated, as is color, with the size of the insect and the temperature in which it is bred. In wing *a* the vein r4 is complete in the normal wasp. It shows a slight break in the specimen figured here. Breaks in this vein are hereditary. Wings *b*, *c*, *d*, *e*, and *f* are non-genetic abnormalities of wings which include omission and addition of veins and remarkable reduplications. (about x8) (Fig. 21.)

yellow, so that insects bred at 32° C. or over are almost entirely yellow, except for compound eyes, ocelli, and antennae, which remain black. The correlation of lighter color with higher temperature may be due to a differential effect of the latter upon formation of integument and pigment.

In size the insect ranges from three and one-half millimeters in well fed wasps, to one and one-half millimeters in those that are less fortunate in obtaining their food supply during growth. Small females lay fertile eggs which develop into adults of normal size. At constant temperature the smaller individuals show relatively more black. Starvation may therefore, like temperature, have a differential effect.

A HEREDITARY DEFECT IN VENATION

In progenies bred from wild stock there was found to be a variation in the venation of the wings. The typical wing shows the fourth branch of the radius, r_4, extending completely across from the third branch of the radius in front to the first branch of the media behind.

In some of the wasps, however, there was a break in this vein of greater or less extent, appearing on one or both wings. The character proved to be hereditary but very irregular in appearance. It was soon noticed that this variation also, as in the case of color, was correlated with temperature and with size. Either at low temperatures or in small specimens the defect is not as likely to appear as at higher temperatures or in larger specimens. Conditions favoring development therefore have a differential effect upon the formation of the wing as a whole and the fourth branch of the radius. When bred at 30° C. the temperature at which the wasps are reared, different inbred stocks

FEMALE WASPS WITH ABNORMAL ANTENNAE

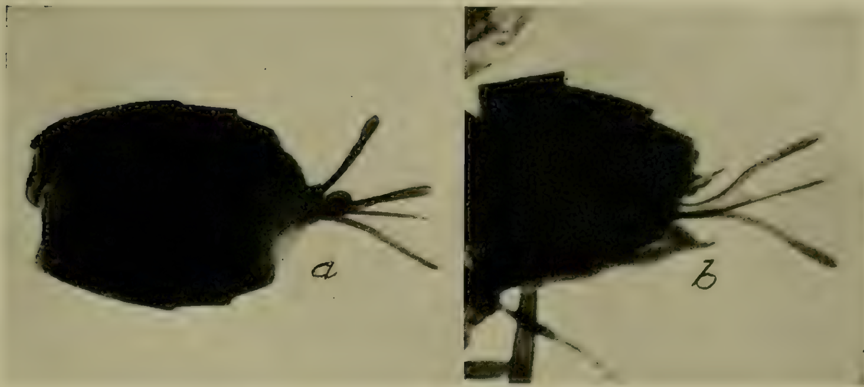
Non-genetic abnormalities of antennae include branching and asymmetrical shortening or omission. The females in the above photographs show also genetic defects of venation—the vein r4 (see wing *a* in Fig. 1) (about x11) (Fig. 22.)

show much variability in number of defectives as well as in the extent of defect in those affected. One stock, called type, has produced only one defective in several thousand individuals. This wasp had one wing normal while the other lacked r_4 altogether. It bred like the rest of the type stock and hence the defect was purely somatic. Other stocks regularly produce one or two defectives in three or four hundred individuals, while still others have about ninety percent defective, the mode appearing in the class lacking r_4 in both wings, completely or almost completely. Crosses of type with high grade defective stock illustrate sex-linkoid inheritance, the males resembling the maternal strain while the heterozygous females are for the most part normal showing, however, variation to defectiveness of intermediate grade. These females when isolated produce normal and defective males in numbers almost equal, there being a slight excess of normals, corresponding to the somatically normal in defective stock. It is clear that the high grade defective stock differs from type by one Mendelian factor affecting the wings.

ORANGE MUTATION

In a single individual appearing among the 254 male offspring of a virgin female the eyes, both compound and simple, were orange instead of the typical black. This male was crossed to various black-eyed females and black-eyed sons and daughters resulted. When these were mated together, they produced black and orange males in equal numbers, but all the daughters were black and indistinguishable from black stock. The failure of orange to appear among the daughters of black-eyed fathers, shows that the males are not heterozygous, but haploid. In other words, all the spermatozoa produced by any one male are alike. Since black is dominant and all females result from fertilized eggs, all the daughters of any black-eyed male must be black. The orange mutant was crossed to a few of his heterozygous daughters. Orange and black females as well as males were produced as expected. Heterozygous females isolated as virgin have given black and orange males in equal numbers. Orange females isolated as virgin produce only orange males and orange stock breeds true.

When orange females are crossed to black males all daughters are black and breed like normal heterozygotes according to expectation. The sons for the most part are orange arising presumably from unfertilized eggs. A few however are regularly black deriving their eye color from the sperm and



FEMALES WITH MORE THAN NORMAL NUMBER OF APPENDAGES

The female normally has, in addition to the sting, two sensory gonapophyses. Additional appendages of similar nature may occur, however, as shown in Figure *a*, or one of those normally present may be bifurcated or forked as shown in Fig. *b* (about X11.) (Fig. 23.)

hence arising from fertilized eggs. These anomalous blacks have been tested with virgin orange females and have usually proved sterile. Only male offspring of normal matroclinous character result, as from virgin females. In a few cases, however, females have been produced although in very small numbers. These females may bear the black eye color of the patroclinous male parent or they may have orange eyes showing their father to be a mosaic. Further evidence of the mosaic character of some of the patroclinous males is now being accumulated by crossing orange females with defective veins by type males. The resulting orange male offspring have defective veins thus showing both maternal characters, while the anamolous blacks have for the most part the normal paternal wings. In a few cases, however, they show the maternal defect in the wings combined with the paternal black eye color. In a single case an orange-eyed brother of anomalous black males bred like a black showing that although his eyes were of maternal origin his gonads were paternal. A very few gynandromorphs or sex mosaics have likewise been produced.

A survey of experimental and cytological work done on Hymenoptera shows that with the possible but doubtful exception of certain of the saw flies, the lowest family of the order, males have the reduced chromosome number, while females, whether produced sexually or parthenogenetically are diploid. The mixed and more or less patroclinous drones of the honey bee derived from crosses of black German or French and yellow Italian races may, as in Hadrobracon, be haploid mosaics in which certain parts of the body contain only maternal nuclei, while in other parts the nuclei are derived from the sperm. It may be supposed that the unfertilized reduced egg nucleus commences parthenogenetic cleavage producing nuclei or maternal blastomeres without capacity for fusion with the male pronucleus. The latter then undergoes cleavage forming paternal blastomeres. The definitive embryo is therefore formed in part from paternal, in part from maternal blastomeres. Gynandromorphism may be tentatively explained by assuming fusion of paternal with maternal nuclei to form the female parts of the embryo.

NON-GENETIC ABNORMALITIES OF GROWTH

Hadrobracon has proved to be subject to numerous deformities of growth some of which are illustrated in accompanying photographs. Legs have shown peculiar swellings and bendings

as well as reduplications. Eyes may be lacking or reduced in size on one or both sides and in one case a small extra eye was located on the cheek and connected with the normal large eye by an isthmus. Occasionally the compound eyes may be fused into one, obliterating the ocelli, or the ocelli may be lacking while the head appears otherwise normal.

Antennae vary slightly in number of joints, shortening being correlated with small size of the body as a whole. Abnormalities of antennae include branchings of various types, as well as extreme shortening, or failure to appear at all on one or both sides.

Females normally have one pair of elongate sensory gonapophyses in addition to the sting. An additional gonapophysis of varying shape not infrequently appears on one or both sides, or one of the pair normally present may be misshapen.

Wings vary occasionally in number of veins both by addition or extreme reduction.

Not infrequently the external genitalia of males or females may be much reduced or lacking altogether. There may likewise be complete failure of the midgut to connect with the hindgut and Malphigian tubules may be much reduced in length or lacking altogether. Defects in hindgut are correlated with defects in genitalia, the abnormalities being due apparently to general growth conditions at the posterior end of the abdomen. Transverse abdominal sclerites may be irregularly arranged, failing to extend across the back in some cases.

None of these growth abnormalities has yet proved to be hereditary, although all types have been tested with the exception of defective genitalia.

From the above account of breeding work with Hadrobracon, it may be seen that while the species is somatically very variable, it is genetically very stable. Only two genetic differences have been found and one of these affecting the venation was derived from wild stock. Orange eye color occurred as a mutation in the laboratory. It is much to be hoped that future studies will disclose further mutations which may be used for analysis of genetic and ontogenetic mechanics.

The writer has been aided much in the work by Mrs. Whiting. He is indebted to the American Association for the Advancement of Science for research grants to purchase equipment and supplies. He also wishes to express gratitude for laboratory facilities provided at Woods Hole and Cold Spring Harbor. Samuel B. Doten of the University of Nevada has assisted much with suggestions in regard to technique and with photographs of the living insects.

Corrections in Previous Articles

The description of "A Living Double-headed Calf" in the JOURNAL for May 1921 contained the statement (page 239) that: "The upper jaw-bones of each mouth seem quite normal except for the absence of the front teeth."

Cattle breeders and others interested in genetics desire to censor that statement for very obvious reasons! The JOURNAL is prompt to acknowledge the correctness of their challenge. From the fact that the calf's head contained so many *abnormalities* it is assumed that the observer did not expect to find any *normalities*, and the misstatement was passed unnoticed by subsequent readers of the manuscript until it boldly presented itself on the printed page.

In the JOURNAL for April 1921, the designations of Daturas (Fig. 16) *in the text on page 190* should be reversed from the order in which they appear, that is, No. 1 should read No. 4; No. 2 should be No. 3; No. 3 should be No. 1; and No. 4 should be No. 2, of D. *pittieri* (not *rosei* as printed).

In the article "Education and the Size of Families" (April 1921, page 190) the statement "co-educational colleges" should read "men's colleges."

HERITABLE CHARACERS OF MAIZE:

IX. CRINKLY LEAF[1]

R. A. Emerson
College of Agriculture, Cornell University, Ithaca, N. Y.

IN 1910 a strain of dent corn obtained at the National Corn Exposition held at Omaha was crossed with a strain of flint corn obtained from the Department of Agronomy of the University of Nebraska. The F_1 plants of this cross were normal and no abnormalities had been observed in the parent strains. But since the latter had not been subjected to self-pollination, there is no assurance that one or other of them did not have in it the character to be described here. In the F_2 generation of this cross there occurred a type of plant that has later been called "crinkly."

Crinkly is a semi-dwarf type of plant, usually about two-thirds the height of normal plants of the same cultures (Fig. 24). The tassels of crinkly are relatively short and compact and not infrequently bear numerous seeds. Sometimes only a few such seeds develop but often a part of the central spike of the tassel is more or less ear-like.

The upper leaf blades of crinkly are relatively short and broad, are usually much crinkled and often have prominent lobes near the base (Fig. 25). All of these characteristics are so variable, however, that some plants classed as crinkly do not show prominently one or other of them. Considering all these leaf characters together with stature and form of tassel, it is usually easily possible to separate crinkly from normal plants, but occasionally the separation is somewhat difficult.

In stocks of crinkly in which the characters noted above are developed to an extreme degree the tassels ordinarily have great difficulty in pushing out from the more or less rolled upper leaves (Fig. 26). It is sometimes necessary to slit the upper leaves to release the tassels and allow the pollen to be shed normally.

The ears of crinkly are usually somewhat smaller than those of normal plants but are not otherwise materially different.

INHERITANCE OF CRINKLY

Crosses of crinkly with normal have invariably given normal F_1 plants. Self-pollinated F_1 plants produced 717 F_2's of which 544 were normal and 173 crinkly, a deviation of 6.3 ± 7.8 from the 3:1 ratio. From backcrosses of F_1 normals with crinkly a total of 3,567 plants resulted. Of these 1,850 were normal and 1,717 crinkly. This is a deviation of 66.5 ± 20.1 from equality. So great a deviation could be expected by chance alone only about once in 38 trials. In some of the backcross progenies the crinkly plants were not so easily separated from normals as in others. It seems likely that this difficulty in identifying crinkly in some cultures may explain in part the deficiency of that type, but it is possible also that crinkly does not survive under crowded field conditions as well as normal plants. Most dwarf and semi-dwarf types of maize, such as dwarf, anther ear, tassel ear, etc., almost always are deficient in field cultures, particularly when grown under unfavorable conditions, and there is no apparent reason to expect crinkly to behave very differently from some of these other types.

Self-pollinated crinkly plants have invariably produced nothing but crinkly progeny. Something over one hundred crinkly plants have been observed in such cultures.

[1] Paper No. 92, Department of Plant Breeding, Cornell University, Ithaca, New York.

MATURE NORMAL AND CRINKLY MAIZE PLANTS

The type of maize called "Crinkly" is a semi-dwarf, usually about two-thirds the height of normal plants. It is so called because of the crinkled character of the leaves, an abnormality which is inherited. Seeds not infrequently develop in the tassels of crinkly, and the tassels are relatively short and compact. (Fig. 24.)

CRINKLY AND NORMAL MAIZE LEAVES

The leaves of Crinkly are not only crinkled but often have prominent lobes near the base of the blades. These leaf characteristics are variable, however, and although it is usually easy to distinguish crinkly from normal plants, separation is occasionally somewhat difficult. (Fig. 25.)

AN EXTREME TYPE OF CRINKLY MAIZE

In some stocks of Crinkly, especially those in which the abnormal characteristics are developed to an extreme degree, the tassels have difficulty in pushing out of the rolled upper leaves. It is sometimes necessary to slit the upper leaves. "The ears of crinkly are usually somewhat smaller than those of normal plants but are not otherwise materially different." (Fig. 26.)

On the whole, it is thought safe to conclude that crinkly is a simple mendelian recessive to normal and that the two types are differentiated by the single factor pair *Cr cr*. That the expression of the character crinkly may be influenced by modifying factors seems likely, however, in view of the noticeable differences in height of plants and in breadth, crinkliness, and lobing of leaves in different stocks.

BUD VARIATION IN THE SUGAR CANE

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LIKE other crops extensively cultivated by asexual methods, the sugar cane is subject to much variation. During the several hundred years in which it has been cultivated it has given rise, literally, to thousands of varieties. In the recent period of deliberate efforts to produce new sorts, many seedling varieties have been secured which are distinguished by characters more or less marked. However, it is the phenomenon of bud variations in the sugar cane, to which it is wished to call attention in this paper.

First, however, in order to show the actual range of variation in this plant, as regards a few of its economic characters, let us cite several examples, regardless of how they may have originated.

FACTORS INFLUENCING YIELD

Sucrose content of the juice, which, together with gross yield in tonnage, determines the value of the crop, varies greatly in the different varieties. To be sure, this is supposed to be influenced by the climatic conditions and the soil, but there are strongest indications that the real immediate factor is maturity as conditioned by the age of the cane. After all, it is a varietal difference, as some varieties have the ability to produce sugar early before they are mature, while others sweeten later. We might call this varietal adaptability to produce sugar *at a given age* as conditioned by climatic and edaphic factors. Thus, while these environmental conditions are determining factors, they are probably only secondarily so as working upon the constitution of the variety itself.

This matter of varieties suited to different soil types is one to which little attention has been given, and yet it is a factor of greatest importance to the agriculturist. In a recent test of varieties at the Insular Experiment Station in Porto Rico, certain varieties were chosen which, it was supposed, might be best suited to the type of soil known as red clay hill lands. These were planted together and at the same time in a field of this type on the station farm. At 14 months from planting analyses show a great range of variation in the characters of sucrose content and purity of juice. Here, close together in the same field and raised under identical conditions, variety D-208 gives juice of 18.40% sucrose and 94.84% purity, others closely following, while B-4596 is only 13.65% sucrose with 85.31% purity and Gigante is 12.32% sucrose with 77.00% purity. It is apparent also, that there is great variation in tonnage amongst these varieties growine here.

STRIKING VARIETAL DIFFERENCES

This planting serves to show three things: (1) the range of variation in important economic characters, (2) the relative adaptability of varieties to different soil types, and (3) in connection with other analyses made month by month, that some varieties mature early and others later. This last fact is one wholly ignored at the present time by the farmers and managers of large centrals. Fields are mixed as to varieties and canes are planted and cut regardless of variety or seasonal maturity.

As to differences in resistance to disease, there are many noteworthy examples. Yellow Caledonia and Cavvangire and Demerara -625 resist the so-called "root-disease" comparatively well, while Otaheite and many others

succumb to it. Otaheite and Calancana, Cristalina and Rayada are most susceptible to gummosis, while Yellow Caledonia and Cavangire are strongly resistant, perhaps immune to it.

D-1135 is very resistant to the ravages of the white grub in Australia, while Otaheite is susceptible. It is well known that Uba and others of the North Indian type of canes are immune to matizado. Otaheite is very susceptible to it.

COLOR AND MARKINGS

Now, having emphasized the fact of such striking varietal differences in economic characters of the sugar cane, let me call attention to a few variations in such superficial characters as color marking. The inference is that, if bud variation is so often and generally occurring in these unimportant characters, it may, and very likely does occur in other and more important characters, such as sweetness and purity of juice, tonnage, disease resistance, drouth resistance, etc.

Cristalina, a deservedly popular, variety, and one very extensively planted in Porto Rico, is a cane yellowish green in color, with a rosy flush where exposed to the light, often so dark as to be almost red. In Cuba, while not devoid of the pink flush, it is practically a green cane. The morphological characters which distinguish this variety remain, however, the same in both localities. Another popular variety, the Rayada, is essentially the same as Cristalina except that its canes are striped with longitudinal red bands. Another variety, Morada, differs from Rayada and Cristalina only in color. Its canes are a solid deep red. Now, it is no uncommon occurrence that these three varieties sport into one another. Cristalina plants throw bud sports that are striped. Rayada plants throw sports that are either solid red like Morada or green with reddish flush like Cristalina. Seedlings from Cristalina do sometimes show stripes but this is rare. Perhaps one seedling out of one thousand from Cristalina would be striped. It is more than likely, tho not known, that Rayada arose from Cristalina as a bud sport, and Morada from Rayada.

Calancana or Imperial de Brazil, sometimes called Green Ribbon, is known to be a sport from Otaheite. It is a green cane with pink stripes, while the Otaheite is plain green. At the present time one Calancana plant in the fields of the Insular Experiment Station has reverted to its parent. Variety, two stalks from its roots being green like the Otaheite. Besides the green-and-pink striped sport from Otaheite, called Calancana, it has also given rise to a red- and white striped variety.

We have recorded[1] that the variety Mignonne, a green-striped cane, gave rise in Mauritius to a self-colored bud variation which is now known as the variety Lousier. This is no doubt very similar to the variety Otaheite, and if not identical, the two cases present parallel behavior in their sporting. The Lousier subsequently gave rise also, by bud sporting, to the green striped Lousier, also known as Green Ribbon and the red-striped Lousier or Horne, and the red Lousier or Lousier Rouge.

The plain green Salangore has sported to a pink-striped cane, and similarly, Porto Rico 317 has thrown bud sports with pink stripes.

A plant of the variety Calancana in one of the experimental cultures now growing at the Insular Experiment Station, has several canes with white leaves (see illustration). Obviously, as these canes are dependent on the resst of the plant for sustenance, they could never give rise to new and independent varieties.

NEW VARIETIES FROM BUD SPORTS

Now, the significance of these facts stated above and illustrated with a few instances that are well known to

[1] Department of Agriculture, Mauritius, Bul. 2, 5, 1916.

CALANCANA SUGAR CANE PLANT AT THE INSULAR EXPERIMENT STATION, PORTO RICO

There are very many varieties of the sugar cane in cultivation, many of which have come about through bud variation. The varieties differ much in economic value, adaptability, resistance to disease, and in some color markings. The sugar content of the juice, for instance, varies a great deal in the different varieties and largely determines the value of the crop. The plant shown in the photograph is a Calancana, sometimes called Green Ribbon, and it is known to be a sport from the Otaheite, a plain green plant. The Calancana is a green plant with pink stripes, shown here sporting to a cream white. (Fig. 27.)

the writer, is that the varieties of sugar cane do often and frequently throw bud sports which may give rise to new varieties. There are several well known instances of this and because of the excellence of the new varieties they have become popular and widely disseminated and extensively planted. A host of other bud sports, because they concerned only superficial characters or characters of no economic importance, or hidden characters, have not been preserved as varieties. If bud sports are so fre-

quently found which are variations from the parent variety in color, may it not be equally true that unobserved variations of qualitative character are also occurring, which concern tonnage, rattooning power, disease and insect and drouth resistance? No doubt this is true. Strains of Cristalina are known to exist which differ from one another in stature, diameter of cane, and consequently in yielding power. Cane fields, even though carefully planted to a single variety, may indeed comprise more than one strain, and if these strains differ in season of maturity, sucrose content of juice and other important economic characters, the result may well be a considerable lessening of financial return to the colono.

In these facts and conditions we have the strongest indications of the necessity for intensive study of cane varieties *as they now exist*, in regard to these unseen, qualitative characters, which are to be detected only by chemical analyses and experimental tests.

HYBRID TYPES OF THE HUMAN RACE

Racial Mixture as a Cause of Conspicuous Morphological Changes of the Facial-type

HERMAN LUNDBORG
Race-Biological Institution, Uppsala, Sweden

IT HAS been possible for recent hereditary research to show that some racial qualities are inherited according to Mendel's law. In 1913, Eugene Fischer,[1] the anthropologist, made a close study of questions of this kind and laid a scientific foundation for hybrid research in the human world.

The morphological race-characters, which are formed through an early and complete ossification—for instance the form, the length, the breadth of the skull etc.—seem to be depending upon heredity in a higher degree than, for instance, the length of the body, which is more easily modified by environmental factors, which depend upon an ossification completed at a later period. I have treated this latter question in a recent communication.[2]

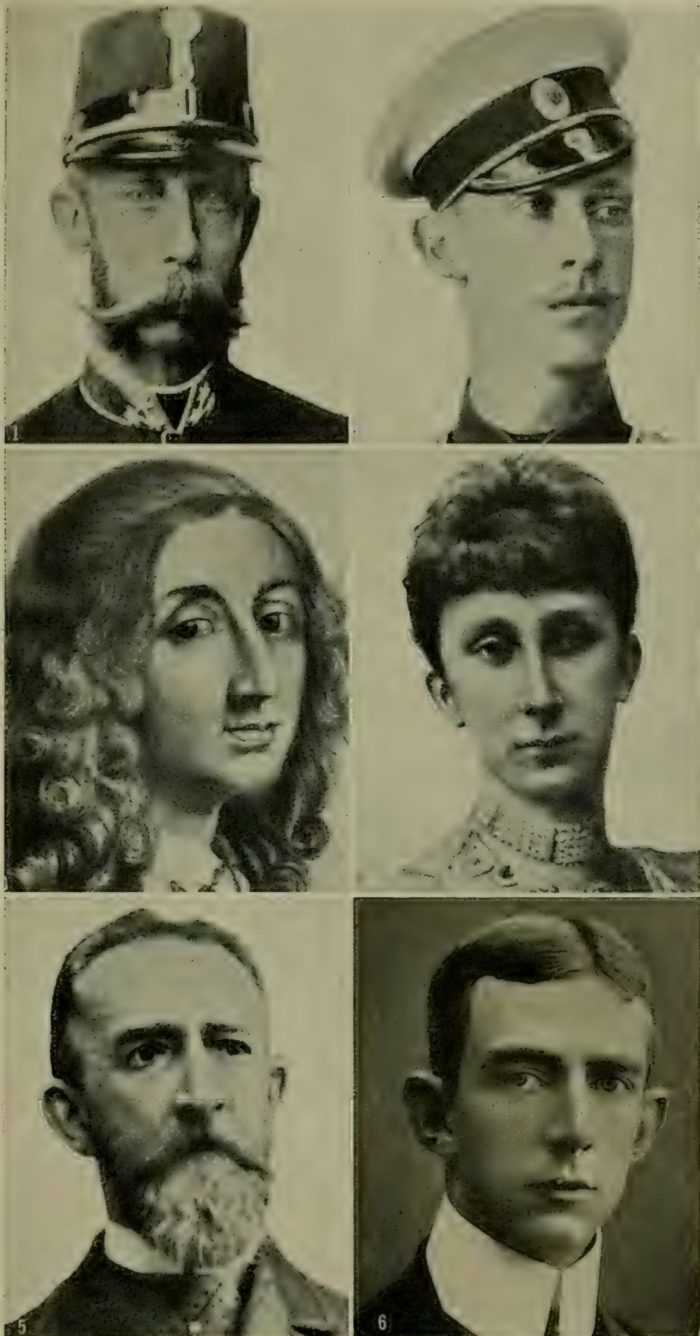
During my travels and investigations in the far north of Sweden, among the population there, which has originated through strong race-mingling among Lapps, Finns and Swedes principally, I could not help noticing that the types vary in a very high degree, and that not unfrequently certain obvious changes of the facial type appear, which do not appear among individuals of a purer race. The numerous recombinations of the genetic structure are probably important causes for this circumstance. There will spring up, it seems to me, in these racial hybrids, besides qualities depending solely on the germ-plasm, in many respects stronger modifications, which probably are to be considered as a partial atrophy. Similar phenomena are often observed in crossings in the vegetable and the animal world.

RESULTS OF RACE CROSSING

Among more conspicuous and comparatively frequently appearing divergences of the morphological structure of a mixed-race population of this kind (if not always in the first generation, then in the subsequent ones) are to be mentioned an increase of bodily length a stronger and more graceful body formation than is found in the parental races, a narrower and more elongated

[1] E. Fischer, Die Rehobother Bastards und das Bastardierungsproblem beim Menschen. Jena 1913.

[2] H. Lundborg, Rassenmischung-vermehrte Heterozygotie (Genchaos)-Konstitutionsveränderungen—Habitus asthenicus sive paralyticus (Zunahme der Körpergrösse usw.)—Tuberkulose. Eine Ursachenvette. Hereditas, Bd. II. Lund 1921.



Ludwig Victor, Archduke of Austria, Emperor Franz Joseph's brother.

Dmitri Constantinovitsch, Grandduke of Russia.

Queen Kristina of Sweden, daughter of Gustavus Adolphus.

Zarevna Marie-Louise of Bulgaria, nee Princess of Bourbon-Parma.

Hans, Prince of Schleswig-Holstein-Glücksburg.

Vilhelm, Prince of Sweden

RACIAL MIXTURE IN ROYAL FAMILIES

Racial mixture has taken place in all the royal families of Europe. One of the effects of this hybridization seems to be "a narrower and more elongated face" than that possessed by either of the parental races. It does not always occur in the first generation, however. The illustration shows some members of different royal families. (Fig. 28.)

face, especially in its upper part. It is to this latter phenomenon that I wish to draw attention in the following discussion. Judging from circumstances, it occurs in a certain percent among race-mixed human elements everywhere in the world, among socially and economically well situated people, as well as among poor and destitute individuals. At least, I have observed it in different parts of Sweden in crossings between Swedes of the Nordic race type and individuals of other nationalities and races, such as Jews, Walloons, Gipsies, and so on. In the European royal families one very often observes this phenomenon in a great many members, which is quite a natural thing, as more or less strong racial mixture has taken place in all these families. A superficial look at the numerous portraits occurring in Wrangel's great work "The Sovereign Royal Families of Europe" (Les Maisons souveraines de l'Europe, Stockholm 1898) will clearly show this.

The photographs in Fig. 28 are representative. It certainly is no chance that these long-drawn facial types most frequently are to be found in the Russian and Austrian royal families with their heterogeneous blood-mixture. Nor is it astonishing, that all the three kings of the Scandinavian empires, all nearly related to one another, are, like several of their near relatives, especially tall people with rather long faces, and they surpass the Swedes in general, who, nevertheless, belong to the tallest nationalities in the world. The stronger race-mingling in the royal families is most certainly the cause. Also in other countries and continents renowned investigators have observed the phenomenon in question.

Hagen[3] has, as far as I know, first of all been struck by the same among East-Asiatic and Melanesian peoples. He has by exact measurements confirmed his statements that the race-hybrids have longer and narrower faces than both the parental races. Thus there is no doubt as to the correctness of the fact. Later on Fischer[4] has also made similar observations in South-Africa.

Hagen writes about this matter as follows: "While the inland Malays are prevailingly medium, and even long-skulled, but at the same time almost all short and broad-faced, the reverse is true among the mixed or Coast Malays; the head is shorter and the face longer. Both are often found in very pronounced degree. Here we have an absolutely typical appearance of crossing.

"Just where this very remarkable but quite characteristic elongation of the face of the Tamil-Malay cross of the second degree has its basis is a riddle which we at this moment cannot solve. The appearance is not confined to the Tamil-Malay cross, for we shall see it later in the Chinese-Malay cross. If we therefore find long faces suddenly appearing among the chamaeprospic, primitive Malayan peoples, the assumption of crossing is not entirely unreasonable. If we find associated with this long face a short, brachycephalic skull, the thought may become almost a certainty. I have tried to explain this remarkable occurrence thus: that the hereditary tendency of the original race elements was to ascertain degree stimulated to accelerated reaction as soon as through the foreign crossing element the reverted cross became predominant.

North-American full-blood Indians are like the Eskimos distinguished by a very great facial breadth. Boas[5] in 1895 proved that the facial breadth decreases in crossing.

He states: "The fundamental difference between the white race and the Indian shows even in the earliest childhood, therefore one may not trace the narrow face of the whites and crosses to an earlier checking of growth processes, but one must see in it the effect of a different beginning.

[3] B. Hagen, Kopf- und Gesichtstypen ostasiasischer und melanesischer Völker, Stuttgart, 1906.

[4] E. Fischer, l. c.

[5] Fr. Boas, Zur Anthropologie der nordamerikanischen Indianer. Zeitschr. f. Ethnologie. Bd. 27, p. 366.

TYPES OF RACIAL MIXTURE IN SWEDEN

The population of the far north of Sweden has originated largely from the race-mingling of Lapps, Finns, and Swedes. Nos. 7 and 8 above show types of the mixture of Lappic and Nordic blood. Nos. 9 and 10 show types of Swedish-Finnic crosses. No. 11 is a Swedish Vagabond with gipsy blood, and No. 12 is a race-mixed gipsy woman of Sweden (Fig. 29.)

RACIAL MIXTURES IN SWEDEN

The comparatively long faces observed among the racial hybrids in northern Sweden are also observed in other crosses between Swedes of the Nordic race type with other nationalities such as Jews, Walloons, and Gypsies. No. 13 in this illustration shows a Swede with Jewish blood; No. 14 a race-mixed Jew, a criminal, of Russian descent; No. 15 a Swedish Walloon with Nordic blood; No. 16 a race-mixed Swedish woman (tuberculous); Nos. 17 and 18 race-mixed Swedes, criminals. (Fig. 30.)

MIXED TYPES OF UNCIVILIZED PEOPLES

Racial crossings among uncivilized peoples in various parts of the world are illustrated by these types from North America, Asia, and Africa. Nos. 19 and 20 are race-mixed Indians of Mexico and the United States; Nos. 21 and 22 are hybrid types, Tamul-Malays, of Asia (according to Hagen); Nos. 23 and 24 are crosses between Boers and Hottentots in Africa (according to Fischer). (Fig. 31.)

"Upon surveying the collected data, one sees that in the very races which doubtless are purebred, the width of the face, in the middle hardly ever falls below 147 mm. It is therefore almost certain that where this measurement is not reached, there is a mixture of foreign blood.

This survey shows that especially the Cherokees, Trokesen, Micimac, Delaware, and Creek Indians are much mixed, since their face-widths fall below 143 mm—statements which may only be made concerning crosses with other races.

In Figures 29, 30, and 31 are representative facial types, originated by race-mingling in different parts of the world. The distinguishing quality of them all is a comparatively long face, of which especially the upper part is disproportionally drawn out.

The material is partly my own taken from the collections of the Race-biological Institution of Upsala, and partly gathered from American and German works.

It will, no doubt, prove to be a very interesting and significant task for race-biological research to penetrate deeper into these departments, and not only to study special individuals, but to investigate whole families and tribes, and to make exact measurements. In this way we shall, sooner or later, arrive at real knowledge of the innermost nature of such phenomena. It has to be determined, what is of genotypical cause depending on the type of the germ-plasm), and what rôle environment plays. This is a department of research which undoubtedly promises significant conclusions.

Haecker, in a newly-issued work,[6] energetically supports the significance of research of this kind. One ought to use all possible kinds of methods, even evolutionary-historical ones. He writes: "This new research work—historically developed characteristic or race analysis (Phanogentik) investigates the origin of the outer characteristics of the perfected organisms morphologically and physiologically, and seeks to trace their roots step by step back over these active intermediate processes into the earliest possible stage of development.

"The investigation presents itself also as a specific chapter of mechanical and physiological development, and its object differs from the hitherto especially pursued aims of this science in that the new investigation has to do with a special method and race characteristics and does not go forward from the fertilized egg through the developing period but goes back from the finished outer characteristic, a procedure which in some respects reminds one of the methods of the prehistorian, paleontologist, and geologist."

Also Hammar[7] of Uppsala has laid stress upon the importance for race-biology of embryological constitution research.

[6] V. Hæcker, Entwicklungs geschichtliche Eigenschafts. analyse. (Phänogenetik.) Jena, 1918.
[7] J. A. Hammar, Ueber Konstitutionsforschung in der normalen Anatomie. Anat. Anz. 1916.

An Outline of Mental Disorders

MENTAL DISORDERS, briefly described and classified. By Charles B. Thompson, M. D., medical director of the Mental Hygiene Society of Maryland. Pp. 48, price 75 cts. Baltimore, Warwick and York, 1920.

Dr. Thompson's pamphlet offers an intelligent outline and description of the various "insanities," which will be welcomed by interested laymen who find the terminology of this subject confusing. Its plan apparently did not include anything more than occasional incidental reference to heredity; and among "Means of Prevention" eugenics is not listed. P. P.

NECTAR-FEEDING BIRDS OF HAWAII[1]

The Drepanid Birds with Long Curved Beaks Developed Like the Lobelioideae—Curved Tubular Flowers

DR. R. C. L. PERKINS in his introductory remarks to section Vertebrata of the "Fauna Hawaiiensis" states: "Remarkable as are some other members of the *Hawaiian Avifauna*, yet it is upon the *Drepanid* birds that the interest of the ornithologist will always be centered. The Drepanideae, include thirty-five species belonging to no less than genera." It may be remarked that the *Drepanideae* are a family of birds peculiar to the Hawaiian Islands and that, as Dr. Perkins states, they are of unknown origin, owing to their dubious relationships with outside forms. "Dr. Gadow has suggested, however, that they are related to the *Coerebidae*, which fact, if certain, would leave little doubt as to their American origin." A large number of the *Drepanideae* are nectar feeders but Dr. Perkins also notes that nectar is never the sole food, though a most important source of nutriment, he says: "Nectar is undoubtedly absolutely necessary to the existence of *Himatione*, *Chlorodrepanis*, *Vestiaria*, *Hemignanthus* and *Drepanis* as they are constituted; small moths, caterpillars, and spiders, their food—would certainly fail them in sufficient quantity at certain seasons." A number of the *Drepanideae* have developed long curved beaks "which make one wonder for what purpose such an extraordinary development can have taken place."

"Practically all the plants visited by birds for food had bell-shaped or tubular flowers in which the nectar was more or less hard to reach; most striking of all are the arborescent *Lobelioideae*, and the multiplicity of these peculiar plants and their isolation from foreign forms bears a striking resemblance to that of the *Drepanid* birds themselves.

Indicating likewise an extremely ancient occupation of the islands, and as the *Drepanid* birds are the pride of the Hawaiian ornithologist, so are the *Lobelioideae* of the Hawaiian botanist." Perkins again says: "the development of the extreme forms of these birds is not comprehensible without a knowledge of the island flora."

"A series of observations made on one of the most superb of the *Lobelioideae* showed that it could only be fertilized by these highly specialized birds. In this species the pollen is mature before the stigma is exserted, by which time the pollen has vanished. The latter cannot be wind-borne because it is shed in a viscid mass on contact and so is constantly deposited on the bird's forehead, from which it is difficult to remove it." To this the writer would remark that birds are not essential to the pollination of *Hawaiian Lobelioideae* though no doubt they are important factors in pollination. In the *Lobelioideae* especially in the Hawaiian species, we find at the apex of the style immediately below the stigmatic lobes and usually on the lower surface of the stigmatic lobes, rows of hair, which are on a level with the base of the tube of the anthers at the time of the pollen-discharge. The pollen remains in the tube of the anthers as the anthers are united and thus the pollen cannot be disseminated. At the time of the pollen discharge within the tube, the style has usually not reached its full length, but it continues to grow and as it pushed through the anther-tube it brushes the pollen with its rows of hair out of the tube, and there the pollen remains adhering to the bristles or bunches of hair, with which usually the two lower, or in some cases all five anthers are fitted out at

[1] From "A Monographic Study of Hawaiian Species of the Tribe Lobelioideae, Family Campanulaceae." J. F. Rock. Honolulu, 1919.

DREPANID BIRDS, THE PRIDE OF HAWAIIAN ORNITHOLOGISTS

The Drenapids are a family of birds peculiar to the Hawaiian Islands Their origin is unknown although they show a relationship to American birds To understand them one must know the flora of the Islands. The birds have developed long, curved beaks, similar in shape to the curved, tubular flowers of the *Lobelioideae* which contain the nectar upon which the birds feed and this striking similarity in form suggests that there has been a simultaneous development. (Fig. 32.)

THE LOBELIOIDEAE, THE PRIDE OF HAWAIIAN BOTANISTS

These flowers bear a striking resemblance in shape to the beaks of the Drepanid birds. Nectar forms the main food for the birds but it is in the long tubular flowers and hard to reach. The curved beaks, however, furnish the necessary tools and, while going after the nectar, these specialized birds have become important factors in insuring the fertilization of the flowers. Lobelioideae very probably existed in Hawaii, with different structural characteristics, long before the Drepanid birds, but the latter have no doubt been the most effective agent in spreading the former. (Fig. 33.)

their apices. It can be seen that dichogamy is not so pronounced that autogamy is not possible. The proterandrous anthers are often eaten by insects or birds (?) and the pollen is thus prematurely discharged.

The base of the corolla tubes, especially those of the large flowering species, is usually filled with great numbers of *Brachypeplus* (small insects with short wings) and the *Drepanid* birds may find in them a source of insect food. Dr. Perkins seems not to have mentioned that fact, though he has often, on being invited, picked off specimens of *Brachypeplus* from dried herbarium specimens of the rarer and new Hawaiian *Lobelioideae.* When one breaks flowering branches of *Cyaneae* or *Clermontiae* especially those with large flowers, the inflorescences become alive with *Brachypeplus* as well as small *Carabidae.*

We can judge from these remarks that the *Lobelioideae* must certainly belong to one of the oldest groups of plants inhabiting this archipelago. Long before there were any *Drepanid* birds the *Lobelioideae* must have occurred in these islands, to be sure not in such numbers, but perhaps in isolated individuals with structural characters probably different from those which are now existing. Since the *Drepanid* birds themselves show a relationship to American birds, we must look to the ancestor of the *Drepanideae* of today as the possible agent of dispersal of the *baccate Lobelioideae.* That the *Drepanid* birds and *Lobelioideae* had a more or less simultaneous development can again be surmised by the fact that in some of the *Drepanid* birds we still find individual variation as regards the length of the bill.—*J. F. Rock.*

A SECTORIAL CHIMERA IN MAIZE

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IN THE rainy season of the last year 1920, some true breeding varieties of maize were sown on the farm of the Agricultural College, Poona, (Bombay Presidency, India), some crosses were made between these varieties. There was one cross between two varieties from the Department of Agriculture—Kashmir State, (northern India). The two varieties concerned were Canadian Red No. 5 and amber pearl pop corn No. 8. One cob as a result of the cross was collected.

The seeds of this cob were sown in the cold weather of 1920. Out of a large number of plants grown from the seeds of this cob, there is one single plant which shows this phenomenon:

The fully grown plant is six feet tall and has one tiller. All the leaves, young and old, of this plant have one half of their laminae bisected by their mid-ribs bearing yellow and whitish stripes. The leaf sheaths and stem are also half striped. The striped halves of laminae, leaf sheaths and stem are all on one side of the plant. The tiller also has similar stripes.

The appearance of these stripes on one vertical half of the whole plant appears to be a case of a sectorial chimera. The accompanying photograph shows the stripes on the leaves very clearly.

One cob on this plant is selfed and it is to be seen in the next (F_2) generation whether seeds of the selfed cob breed true in this character or whether the character disappears altogether. It is expected that F_2 generation will throw more light on the nature of this chimera.

In *Genetics in Relation to Agriculture* by Babcock and Clausen (page 381) it is stated that, "variegated foliage which is caused by factor mutations causing complete or partial chlorophyll reduction are also fairly common among Snapdragon, four-o'clock, geranium and maize plants. The variegated character can be transmitted to sexually produced offspring."

MAIZE PLANT WITH ONE-HALF OF ALL LEAVES STRIPED

Probably a case of a sectorial chimera. It is a first generation plant from a cross between Canadian Red maize and amber pearl pop corn, described on the opposite page. (Fig. 34.)

A LIZARD WITH SERPENTINE FORM

R. W. Shufeldt, C.M.Z.S.
Washington, D. C.

(Photograph by the author; from life)

What did *Ophisaurus ventralis* gain in assuming the serpentine form? *Ophisaurus ventralis* is the scientific name for the common "Glass Snake"—a lizard with serpentine form, and perfectly devoid of the slightest semblance of any external limbs. It ranges over the eastern part of the United States, from North Carolina westward to Wisconsin, and from thence southward into Mexico. Specimens have been taken having a length of nearly forty inches; but that is very unusual. As a rule, we rarely meet with one measuring over twenty-eight inches. As to the general appearance of this perfectly harmless saurian, it is well portrayed in the accompanying cut, which is a reproduction of a photograph of a medium sized specimen sent me alive from Florida, where the form is very abundant.

Many know this lizard by the name of "Glass Snake," for it can *voluntarily* part with its tail, which may come away in one, two, or three pieces, but not in *ten* to a *dozen*, as vouched for by the zoölogical mythmongers. The tail will grow out anew, but always shorter, and with a somewhat different appearance. Its vertebræ are cartilagenous. In contradistinction to the snakes, *Ophisaurus* possesses both well developed ear-openings and eyelids. In nature it loves to burrow below the surface of the ground, especially in somewhat marshy soil. Here it finds earth worms, insect larvæ, and the other forms it lives upon, while above ground it will eat the eggs of small birds, grasshoppers, spiders, and the like. Our king snake is its greatest enemy, for that reptile captures and consumes many of them in the course

of a year, swallowing them whole—and *Ophisaurus* does not possess the necessary speed to escape this tyrant among our reptiles.

With respect to color, *Ophisaurus* is beautifully marked, the scales of the head each possessing a fine dot of green; the sides are striped, the dorsum ranging from dark brown to black; while the ventral surface is of a fine shade of pale yellowish green—often almost greenish white. The entire surface is very glossy, and the feel to the hand that of porcelain or smooth glass.

In 1881, I published, in the Proceedings of the United States National Museum, a complete account of the osteology of *Ophisaurus*, and I showed therein that while the form does not possess rudimentary humeri, it does have the *femora* in that condition, and they articulate with the pelvis in the usual manner. Otherwise the limbs are but vestigeal structures, and the general morphology of the animal is that of a true lizard.

Taking everything into consideration, there is no doubt but that *Ophisaurus ventralis* is descended from some ancient species among the *Anguidæ*, and herpetologists generally hold that it is a "degenerate."

Now comes the question: what did *Ophisaurus* gain in gradually passing from the form of a true, four-limbed lizard to that of a serpent without the semblance of limbs? My contention is that it lost in every essential particular—that is, in so far as the assurance of the perpetuation of its race is concerned. Its resemblance to a snake probably trebled the number of its enemies; it by no means gained the agility of a snake—hence it cannot so well make its escape; and it possesses no advantage over most lizards in the fact that it can voluntarily part with its tail. To some extent its coloration is protective; but not nearly so much so as it is among many lizards, as *Anolis* and the chameleons. Finally, it is but an average swimmer—water being an element in which many serpents are perfectly at home; it soon drowns if compelled to remain under the surface of it.

What switched the ancestors of this lizard serpentwards it is difficult to conjecture, and suggestions on this point are quite in order.

BROTHERS IN COLLEGE FOOTBALL

A Brief Study Showing That Brothers Are Often Selected to Play the Same Positions on Football Teams

R. E. Klingensmith
University of Pittsburgh

A LIST of 29 sets of brothers who are playing, or previously have played college football under coaches who presumably knew the positions to which they were best fitted, shows that 24 pairs were fitted to play similar positions, and 5 pairs to play positions which are entirely different as to physical requirements and training.

In this connection, ends who had brothers playing in the back field were considered in the same class, because the requirements of the two positions are much the same. Ends and backs must be faster and possibly think more quickly than the heavy lineman.

Of the 24, two sets are listed as playing different positions, but they were made over from similar positions to fill the needs of their respective teams.

Some notable athletes who seem to run to type are the Poe boys of Princeton, of whom there were five, all backs or ends and all exceptional drop-kickers. Much of this ability probably came through training, for it is known that these boys spent hours at

a time throughout their summer vacations, practicing kicking.

The Nesser boys, who came from near Wheeling, play all positions. There are reported to be from five to nine of these brothers, and all of them weigh over 200 pounds each.

Outside of football, the field of sport shows few instances where brothers have inherited similar abilities. Two notable exceptions are the Shields boys of State and Penn, each of whom could run a mile under 4.25. Five Delehanty brothers have all played more than a year in big league baseball.

The reason for this is probably that sports other than football depend much more on specialized abilities. Football is based largely on physical strength.

The data here come only from the memories of a few men. If the records of brothers playing football were complete they would still be only a small percentage of the number of boys playing football who have brothers not playing at all.

If we could sift the qualities which make up a football player down to the most vital they would probably be temperament and physique.

Both of these qualities depend upon a number of things, so that neither is often inherited intact. This is the probable reason that so many football players have brothers who do not play at all.

However, our records show that when brothers do play football, the proportion of those playing similar positions is too great to be mere coincidence.

The following is a tabulated list of players and positions.

TABLE I

Player	*School*	*Position*
McCrea	Yale	Guard
"	"	"
Hickock	"	"
"	"	"
J. Wagenhurst	Penn	Center
O. "	"	Tackle
A. Stevenson	W. Va.	Guard
J. "	Pitt.	Tackle
G. Warner	Cornell	Guard
W. J. Warner	"	"
J. Minds	Penn	Back
"	"	"
Lueder	Cornell	Tackle
"	"	"
Cool	"	Back
"	"	Center
G. Rosengarten	Penn.	End
A. "	Princeton	Back
A. Wilson	Yale	Quarter
W. "	Princeton	End
T. "	"	Guard
E. Trenckman	"	"
F. "	"	Back
W. Banbury	Pitt	Half
Q. "	"	"
Callahan	Yale	Center
"	Princeton	"
H. Miller	Penn	End
R. "	"	"
H. Stein	Pitt	Center
R. "	W. & J.	Tackle
H. Robertson	Syracuse	Center
J. "	Dartmouth	Halfback
A. Bremen (Taken back from line)	Pitt	Fullback
B. Bremen	Pitt	Tackle
L. Wray	Penn	Center
A. "	"	Guard
V. Alshouse (Once played end)	Pitt	Tackle
R. Alshouse	"	End
B. Aiken	W. & J.	"
A. "	"	"
Ewing	State	End
"	"	Quarter
E. Neale	W. V. W.	End
"	W. V. U.	Back
A. Norween	Harvard	"
R. "	"	"
Morrow	Northwestern	End
"	"	"
R. Fletcher	Illinois	Quarter
"	"	Half
W. Gardner	Penn	Quarter
"	"	End
B. Pierce	Carlyle	Guard
A. "	"	Guard and Back
Wauseka	"	Tackle
P. Hauser	"	Back
R. Baldwin	Allegheny	End
J. "	Tech.	Back
5 (6) Poes (Great Kickers)	Princeton	Back & Ends
5 (9) Nessers (All over 200 lbs.)	Wheeling	All Positions

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ORCHARD OF BEN DAVIS APPLES AT THE MAINE AGRICULTURAL EXPERIMENT STATION

Studies made in this orchard of 881 trees show that productiveness is correlated with type of growth, the most productive trees being large, open and spreading in habit, with short laterals and many spurs, while the unproductive ones are small and upright, with slender branches and few spurs. The tree in the left foreground, which is of the latter type, bore an average of 46 lbs. of fruit per year, while that in the right foreground yielded an average of 226 lbs. per year during the same five-year period. While differences in soil conditions are probably responsible for a certain amount of variation in tree growth and productiveness, the authors believe that the type of root stocks used is also of great importance. They hold that there is no critical evidence to show that differences in productiveness within a clonal variety, such as the Ben Davis, are due to bud variation. (Frontispiece.)

PRODUCTIVE AND UNPRODUCTIVE TYPES OF APPLE TREES

STUDIES IN ORCHARD MANAGEMENT. IV.[1]

Karl Sax and John W. Gowen
Maine Agricultural Experiment Station

IN AN apple orchard containing trees of the same age and variety it is usually possible to distinguish trees which have different habits of growth. The question naturally arises whether these differences in growth habit are correlated with differences in productivity. A study of the tree type and yield of fruit was, therefore, undertaken with 881 Ben Davis trees. The trees are of the same age—about 28 years—and during the period covered by this investigation were free from serious injury or disease. They were classified according to type or habit of growth, and annual records were kept of the yield and growth of each tree.

In the present paper will be considered the characteristics of the various types of trees, the relation between type and yield and type and circumference, and the factors which may cause the different tree types. In presenting these data the authors wish to express their indebtedness to, and appreciation of, the work of Dr. Frank M. Surface, under whose direction most of the data for this study were collected.

TYPES OF BEN DAVIS TREES

A study of variation in the habit and amount of growth of Ben Davis trees reveals two principle contrasting types, type 1 and type 3, and certain intermediate types intergrading between the two main types.

Type 1 is a large vigorous tree with an open head. The branches are large and often drooping; and many laterals are present with abundant spurs. (See Fig. 1.)

Type 3 is a rather small tree with small upright branches. Its branches are slender and have few laterals or spurs. (See Fig. 3.)

Between types 1 and 3 are a number of integrading types whose position in the series is determined by their resemblance to the types described above. Type 2 may be regarded the center around which are grouped the other types in the series. Type No. 2 is characterized by a vigorous growth, spreading head, stout numerous and drooping branches (Fig. 2). It differs from type 1 in that it has longer laterals and fewer spurs. Type 2 grades off to type 1 through types 2-1 and 1-2, the latter approaching type 1. Similarly, the distance between types 2 and 3 is bridged by type 2-3 and 3-2 the former approaching type 2, the latter type 3.

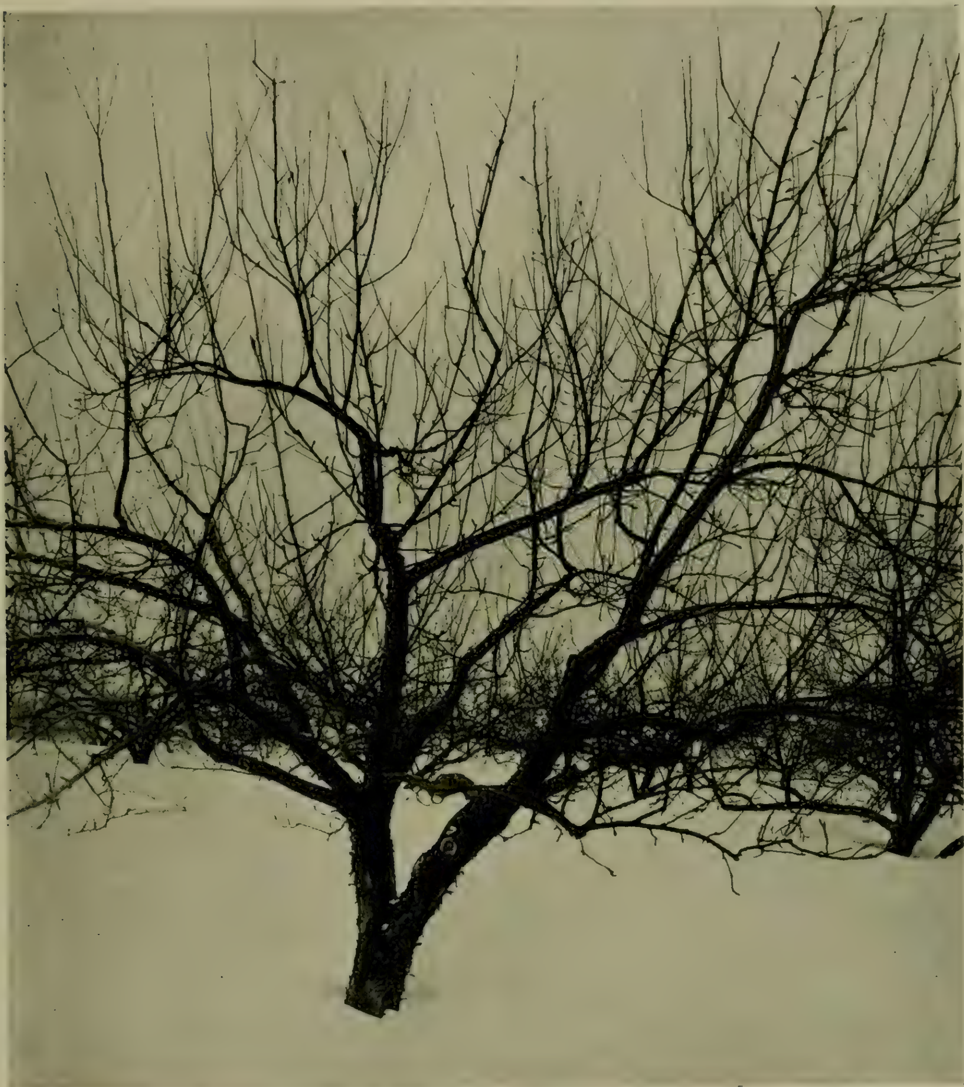
RELATION BETWEEN TYPE AND YIELD

In general, trees of type 1 are the most productive and the average productivity decreases for the intermediate types as they approach type 3. Type 3 is very unproductive, and even in the most favorable year the trees of this type bore an average of little more than one bushel of fruit per tree. The distribution of the yields of the various types together with the means and degrees of variability are shown in Table 1.

[1] Papers from the Biological Laboratory, Maine Agricultural Experiment Station No. 150.

PRODUCTIVE TYPE OF BEN DAVIS APPLE TREE

Large, open, spreading trees such as the one here shown have been found to be more productive than small, upright trees with slender branches and few spurs. In the studies made at the Maine Agricultural Experiment Station it was found that 121 trees of the type shown above (which is termed *type 1*) produced an average annual yield of 191 lbs. of fruit per tree during a five year period. The authors believe that the selection of large, vigorous root stocks will tend to produce trees of this type. (Fig. 1.)



A TREE OF INTERMEDIATE CHARACTER

Between the productive type of Ben Davis apple tree (type 1) and the unproductive one (type 3), the authors have found a large number of trees which must be considered as intermediate in character. These they have placed in a separate group, which they call type 2. During the five year period from 1914 to 1918, 233 trees of this type produced an average annual yield of 113 lbs. of fruit per tree. It may be mentioned that the classification of productive and unproductive trees into these three types is somewhat arbitrary, since there are numerous trees which do not properly fall within any one of the three groups, but are intermediate between two of them. The classification has, however, been found to serve a very practical purpose: unusual productiveness is shown to be correlated with a certain type of growth. (Fig. 2.)

In 1914, the most favorable year, the average yield of the 121 trees of type 1 was 283.7 pounds or more than 2 barrels per tree, while the average yield of the 136 trees of type 3 was only 40.1 pounds or less than a third of a barrel per tree. The 233 trees of type 2 averaged 190.3 pounds or nearly a barrel and a half per tree in 1914. Of the total number of trees

Table I: Average yields of the types of trees for 1914-18.
Mean Yields in lbs. of fruit.

Type	No. of trees	1914	1915	1916	1917	1918
1	121	283.72±4.31	220.58±3.82	178.43±3.50	117.60±2.71	151.82±5.12
1-2	77	243.25±4.67	185.58±4.41	146.36±4.15	87.92±2.42	122.21±5.87
2-1	131	228.01±4.17	166.79±2.71	127.10±3.45	82.06±2.45	85.57±3.37
2	233	190.34±3.13	137.55±2.39	99.01±2.55	70.00±1.82	67.60±2.79
2-3	101	139.70±4.65	102.87±3.20	75.54±3.23	56.14±2.43	64.85±4.13
3-2	82	89.76±4.67	78.54±2.86	58.29±2.97	45.12±2.63	52.93±4.04
3	136	40.15±2.35	47.79±2.11	41.03±1.99	27.06±1.37	40.44±2.34
Total	881	175.20±2.32	134.54±1.67	102.62±1.53	69.64±1.05	81.09±1.65

(881) more than one-third produced less than one barrel per tree, due largely to the presence of unproductive types of trees.

In the table given above it is evident that the trees of type 1 are the most productive and that the productivity decreases as the intermediate types approach type 3. It is possible to measure accurately the degree of correlation between tree type and yield by determining the correlation ratio. These measures of correlation are shown in Table II for the years 1914-18.

The correlation of .50 to .70 indicates that *tree type* is a reliable indication of the probable yield of the tree.

Table II: Ben Davis Apple Orchard. 881 trees.
Correlations between type, yield and circumference.

	Year	Correlation Coefficient	Correlation Ratio
Correlation between type and yield	1914		.77±.01
	1915		.74±.01
	1916		.64±.01
	1917		.58±.01
	1918		.49±.02
Correlation between type and circumference	1914		.72±.01
	1915		.69±.01
	1916		.66±.01
	1917		.67±.01
	1918		.66±.01
Correlation between circumference and yield	1914	.79±.01	.81±.01
	1915	.75±.01	.76±.01
	1916	.71±.01	.75±.01
	1917	.60±.01	.61±.01
	1918	.49±.02	.52±.02

In other words we would, in general, be justified in using tree type as a means of judging which trees are unproductive and unprofitable.

The correlation ratios between type of tree and circumference of trunk are also determined. The high degree of correlation (see Table II) between type and circumference indicates that type 1, or productive trees, are in general the largest trees, and that the type 3 or unproductive trees are as a rule small. These results indicate that yield is closely associated with the size as well as type of tree. The relation between circumference of trunk and yield is shown in Table II. Both the correlation coefficients and correlation ratios are high, indicating that yield also is closely correlated with size of tree. The question immediately arises: to what extent are the differences in yield of the various types due to differences in the size of the trees of each type? By determining the correlation between type and yield with the tree circumference held constant little or no correlation between type and

AN UNDESIRABLE TYPE OF BEN DAVIS APPLE TREE

In an orchard of 881 trees, there were 136 of this type, which has been called type 3. The average annual yield of these trees during a five year period was only 39 lbs. of fruit per tree, as opposed to 191 lbs. for trees of type 1, and 113 lbs. for trees of type 2. The unproductive trees are rather small, upright in habit, with slender branches and few spurs. (Fig. 3.)

yield of trees is found. From this it may be concluded that yield is, in general, dependent on the size of the tree and that differences in size of trees of the same age are closely associated with a rather definite type of growth.

THE CAUSE OF PRODUCTIVE AND UNPRODUCTIVE TYPES

Consistently unproductive trees have often been attributed to inherent differences resulting from bud mutation. In other words certain varieties are thought to contain high and low yielding strains of trees. There are however, a number of factors which may cause consistent differences in the productivity of trees in the same orchard. The following are the important known factors: 1. Soil heterogeneity, including such permanent differences as soil moisture, depth of soil, elevation, and physical and chemical

properties of the soil, which may cause certain trees to yield more than others from year to year. 2. The seedling root stocks used for apple trees are extremely variable in vigor and type of growth and may cause much variation in yield of trees. 3. Variability in buds or scions of a clonal variety may cause variability in the performance of individual trees. The various known factors which may cause differences in the productivity of trees of a clonal variety will be considered in the above order.

VARIABILITY IN PRODUCTIVITY, DUE TO SOIL HETEROGENEITY

If differences in productivity are due to variable root stocks or variable scions we would expect a random distribution of high and low yielding trees throughout the orchard. If soil variability is the cause of differences in performance we would expect to find the high and low yielding trees in rather definite groups. It is hardly possible that soil differences can be so local in extent as to effect the productivity of but a single tree. Frequently an unproductive tree will be found entirely surrounded by comparatively productive trees. We have dug up several of these trees and in every case the root system of the unproductive tree was so interwoven with the root systems of the productive trees that they had to a great extent a common feeding ground. In no case was the isolated unproductive tree in apparently poorer soil than the productive trees. From this it seems apparent that the isolated unproductive tree cannot be due primarily to unfavorable soil. On the other hand when high and low yielding trees are grouped in definite areas it seems entirely probable that these groups are due to soil conditions.

Ben Davis orchard No. 1 contains 37 rows with 29 to 37 trees per row. The orchard was divided into twenty-five blocks as shown in Table III. The number of trees per block varies considerably, due to missing or replanted trees, or to variations in rows or trees per row included in certain blocks. The distribution of the extreme types of trees is readily observed in Table III.

It will be noted that the total number of trees, the number and percentage of type 1 trees, and the number and percentage of type 3 trees for each block are shown. Thus in the block of trees including rows 1-8, and trees 1-8, we find a total of fifty-

Table III: Distribution of types of trees in Ben Davis Orchard
Showing in each block the total number of trees, number and percentage of Type 1, and number and percentage of Type 3.

	Trees		Rows 1–8	Rows 9–16	Rows 17–24	Rows 25–32	Rows 33–37	
	33-	Total No. trees	28	12	8	1	0	
		No. and % Type 1						
		No. and % Type 3	4–14	2–17				
	25–32	Total No. trees	62	59	49	43	25	
		No. and % Type 1	4–6	6–10	2–4	5–12	3–12	
		No. and % Type 3	5–8		2–4	1–2	2–8	
N	17–24	Total No. trees	64	60	56	36	31	S
		No. and % Type 1	8–12	4–7	9–16	15–42	5–16	
		No. and % Type 3	4–6	2–3	4–7	1–3	4–13	
	9–16	Total No. trees	63	63	51	41	33	
		No. and % Type 1	20–32	16–25	5–10	18–44	2–6	
		No. and % Type 3	3–5	2–3	2–4	4–10	3–9	
	1–8	Total No. trees	51	57	56	49	33	
		No. and % Type 1	3–6	8–14	1–2	2–4	1–3	
		No. and % Type 3	15–29	15–26	26–46	27–53	17–52	

one trees. Of these fifty-one trees, three or 6% are of type 1, while fifteen or 29% are of type 3. A study of the distribution of the two extreme types, 1 and 3, shows that they are in rather definite areas of the orchard. Most of the type 3 or unproductive trees are located along the west side of the orchard, especially towards the south end of this area. The location of the unproductive trees coincides very closely with the high sandy portion of the orchard. Clearly the grouping of the unproductive trees is due to unfavorable soil conditions or exposure. The type 1 or productive trees are grouped largely in the west-central part of the orchard, especially in the blocks including rows 1-16, trees 9-16, and the blocks including rows 25-32, trees 9-24. In these four blocks the percentage of type 1 trees varies from 25% to 44%. The grouping of productive trees in definite areas can only be attributed to unusually favorable soil conditions in these areas.[2]

It is clear that the various types of trees, productive and unproductive, are due to a considerable extent to soil heterogeneity. It is also evident that an unproductive type of tree when surrounded by a productive type, all having a more or less common feeding ground, cannot be attributed to unfavorable soil. The behavior of such trees indicates that the various types of trees may be caused by one or both of the other factors mentioned, i.e., root stocks or bud variation.

VARIABILITY IN PRODUCTIVITY DUE TO ROOT STOCKS

We shall consider next the influence of the root stock on type and yield. It is well known that seedlings grown for root stocks are extremely variable both in regard to morphological characters and growth. In our seedling orchard, the 586 trees which were planted in 1911 vary in circumference from two to eighteen cm. and the coefficient of variability was found to be $32.07 \pm .69$. Such great variability would be expected in the growth of seedling apple trees since all apple trees are more or less heterozygous and are usually cross pollinated.

So-called "standard stocks" may vary greatly in growth; Hatton (c) found about 14% of a block of "free stock" seedlings to be distinctly dwarfed and weak. About the same range of variability in root stocks was found in "free stocks," crab stocks, and paradise stocks. The latter stocks are generally considered dwarfing stocks, but both the "free" and "Paradise stocks were found to contain dwarfing and free growing stocks. "Paradise" stocks are apparently from different sources and the variety is not a true clonal variety.

In our "stock and scion" orchard we have over 400 trees of ten varieties. These trees were worked on "French Crab" and Tolman Sweet roots in 1913. An analysis of the data on this orchard shows that in circumference of trunk, in 1921, the trees worked on "French-Crab" stock are more variable than trees on Tolman Sweet roots. This is to be expected, since "French Crab" seedlings are from numerous varieties and types of trees. The Tolman stocks are a clonal variety and are less variable than French Crab stocks.

When the trees for the "stock and scion" orchard were taken from the nursery they varied considerably in size. If these differences in size were due to difference in the soil of the nursery we would not expect these differences to be permanent when the trees were transplanted in the orchard. The random planting of large and small trees should smooth out differences in growth if soil is the only factor involved. If, however, the variation in size of nursery trees is due to the effect of root stocks or scions then differences in size will persist in the trees when set in the orchard.

[2] The soil in our Ben Davis orchard was also found to be heterogeneous when measured by the test for soil heterogeneity proposed by Harris (2). For the average soil heterogeneity based on the yields of the 881 trees for 1914-18, $r = .40$. The individual tree was used as the ultimate unit and trees were grouped in a four by four fold manner for the combination plots.

The buds of each variety were selected from a single tree in each case, thus largely eliminating any possible difference in growth of scion due to bud mutation. The growth of different varieties on different stocks was not found to be the primary cause of correlation between size of nursery tree and the same tree in the orchard. We have found that the trees which are small when set in the orchard are also the small trees in succeeding years. The correlation between circumference in 1916, two years after the trees were set, and the circumference in 1921, was found to be very high ($r = .68$). We may conclude then that small trees in the nursery, in general result in small trees in the orchard, due to a considerable extent to the effect of the root stock.

In citrus trees Webber (j) has found great variability of root stocks, both in size and morphological characters. The variable root stocks are considered one of the primary causes of variability in nursery trees budded on such stock. Webber has shown that large, medium and small nursery trees of Washington navel and Valencia oranges and Marsh grapefruit retain, to a considerable extent, their relative sizes when grown in the orchard for several years. The growth of the different sizes of nursery trees is not given in detail and it may be questioned if the differences in size of orchard trees are significant. Webber attributes many of the irregularities in size and fruitfulness of orchard trees to the use of the seedling root-stocks.

Since root stocks grown from seeds are extremely variable and may often be weak and dwarfed it is not surprising that clonal varieties grafted on such stock varies greatly in growth and productivity. The presence of many unproductive trees in our Ben Davis orchard may be attributed, in part at least, to the effect of weak or incompatible root stocks.

VARIABILITY IN TREE TYPE AND PRODUCTIVITY DUE TO BUD VARIATION

In recent years much of the variability in performance of fruit trees within a clonal variety has been attributed to bud mutation. This belief has been strengthened by the work of Shamel and his colleagues with citrus fruits in California. As a result of Shamel's work there has been a general acceptance of the idea that bud mutation may cause increased or decreased yields, not only in citrus varieties but in other fruits as well.

In a paper, the publication of which has been somewhat delayed, we have analyzed in considerable detail the data pertaining to bud variation in citrus and apple varieties. We will therefore limit the present discussion of bud variation to the more important phases of the work.

Experiments on bud variation in apples have been conducted by Whitten in Missouri, Macoun in Canada, and Cummings in Vermont. Whitten (k) selected scions from an exceptionally poor Ben Davis tree and others from the best Ben Davis tree in the orchard. There was no significant difference in the performance of the progeny of the two extreme types.

Macoun (d) selected scions from a heavy bearing, a regular bearing, and a very unproductive tree in a row of 18 Wealthy trees. A comparison of four years yield of the progeny of the above trees shows no significant difference in the performance of the progeny of the three parental types. In actual amount of fruit the trees resulting from the most productive parent produced slightly less fruit than either the progeny of the regular bearing or unproductive trees. The differences were in no case statistically significant.

Recently Cummings (a) has reported the results of a rather extensive bud selection experiment in Vermont. Scions were selected from productive and unproductive trees of seven varieties. Two hundred and forty-eight scions were used, 120 scions from productive trees and 128 from unproductive ones. At the end of ten years 86 of the "productive" and 82 of the "unproductive" scions had borne fruit. In many cases the two classes of scions were grafted into the same variety

or even into the same tree. In general the scions from the productive trees were no more productive, in fact they were somewhat less productive, than scions from the unproductive trees. The difference in favor of the "unproductive" scions is probably not significant, but at least there is no indication that scions from productive trees are superior to scions from unproductive trees of a clonal variety. In other words the differences in performance of trees of a clonal variety of apples, in the above case at least, are apparently not inherent, but are the result of environmental factors.

The above experiments do not indicate that unproductive types of apple trees are due to inherent differences. Let us now examine the data on bud variations involving productivity in the citrus fruits.

Shamel and his colleagues (f-i) have published four bulletins giving records and performance of 151 Washington Navel orange trees, 105 Valencia orange trees, 117 Eureka lemon trees and 121 Lisbon lemon trees. In all cases trees of a clonal variety may vary greatly in performance. Certain tree types or "strains" are often associated with high or low productivity. An analysis of Shamel's data shows considerable grouping of high and low yielding trees, indicating that soil is probably an important factor in the differences in performance of the various strains. Unproductive trees have been top worked with buds from productive trees and although some of these trees have been top worked over eight years no records of their performance have been presented. *The only evidence presented to support the occurrence of inherent differences involving productivity in clonal varieties of citrus trees is the fact that among trees of the same variety, age, and under similar conditions some are low yielders and others are high yielders.*

There is no critical evidence in any clonal variety of fruit trees that bud variation is the cause of differences in productivity. Clonal varieties of apples are just as variable as clonal varieties of citrus trees, but independent workers using different varieties have all found no significant differences in the progeny of buds from productive and unproductive trees. That the results in the citrus, when finally presented, may be found to agree with those in the apple is indicated by the latest recommendations of Shamel. (U.S.D.A. Bull. 813, p. 84).

Until it is shown that buds from productive and unproductive trees of a clonal variety result in productive and unproductive trees respectively, the conclusion is not justified that differences in productivity of trees within a clonal variety are inherent. If such differences are not inherent, unproductive trees, such as our "Type 3," cannot be made productive by top-working with buds or scions from high yielding trees.

CONCLUSIONS

A study of 881 Ben Davis trees shows that productive and unproductive trees are closely associated with definite types or habits of growth. The productive, or type 1, trees are large, open and spreading, with short laterals and many spurs. The unproductive, or type 3, trees are small and upright with slender branches and few spurs. Between these two extreme types are a number of intermediate types.

Differences in productivity of trees of a clonal variety may be attributed to soil, root stocks, bud variation, or to unknown factors. In the Ben Davis orchard, soil was found to be an important factor in causing differences in type and yield of trees. The influence of favorable or unfavorable root stocks is also an important factor in tree growth and productivity. There is no critical evidence that differences in productivity within a clonal variety are due to bud variation. There is then no justification for top working unproductive types of trees with buds or scions from productive types. In the selection of root stocks it is advis-

able, as Webber has suggested, to use only large, vigorous stocks for grafting or budding. The use of clonal varieties of root stocks would undoubtedly result in more uniform and, in general, more productive trees.

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Mental Hygiene

MANUAL OF PSYCHIATRY, edited by Aaron J. Rosanoff. Fifth ed.; revised and enlarged. New York, John Wiley & Sons, 1920, pp. 684.

The manual is comprehensive. Although based on Kraepelin's classification, it finds room for Freud and 150 pages or more of mental tests. As to why one "goes insane," "The situation may be summarized as follows: at least three-fourths of all cases of mental disorders occur on the basis of bad heredity, alcoholism, drug addictions, or syphilis; an individual who is of normal ancestry, abstains from alcohol and habit-forming drugs, and remains free from syphilitic infection, is not seriously threatened with a mental disorder. But since alcoholism and syphilis are, in their turn, so generally connected either directly or indirectly with inherent mental defectiveness, it follows that heredity is, as long taught with characteristic clearness of thought and diction by the French school of psychiatry, the cause of causes of mental disorders." It is further indicated that "most of the inheritable mental disorders, are, like the trait of blue eyes, transmitted in the manner of Mendelian recessives," the publications of the Eugenics Record Office being cited to support this.—P. P.

WHAT IS THERE IN PHYSIOGNOMY?

I. THE SIZE OF THE NOSE

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As we go on through life we all acquire a certain amount of critical discernment regarding the human face. Some people, whose occupations have naturally brought them in contact with a vast number of varying types, acquire special skill. Hotel clerks, for instance, physicians, lawyers, business leaders, travelling men, etc., become very adept in what is popularly known as "sizing people up." It is probable that girls begin this science of face study much younger than boys since they need it as a matter of defense and protection, and all through life women are perhaps superior to men as physiognomists. This is usually spoken of as woman's intuition, but there is probably nothing more mysterious about it than that women have paid more attention to the subject.

WHAT DO OUR "LOOKS" SIGNIFY?

Those who say there is nothing in physiognomy are for the greater part protesting against the extreme and absurd claims of all the cranks and quacks—first cousins and half brothers to the palmists, the astrologers and the phrenologists. For the admission that there is something in physiognomy is necessitated by common everyday experience. Great men certainly do not look like imbeciles, nor do Eskimos and African Bushmen look like courtiers and heroes. There is a line of truth to be drawn somewhere, but just where that line lies has never been determined, even approximately. The true methods of inductive science have not been applied to establishing associations between facial peculiarities and mental traits.

It is a fair hypothesis that at least some associations exist. Man has evolved from an ape-like ancestor characterized by a small nose, small eyes, retreating forehead and chin. Why should not the most intellectual of men depart more than the "common run" of men from such primitive proportions? Indeed, there is a widespread popular fancy that a high forehead and long nose are marks of intellect, and a heavy chin is a sign of force of character. In fiction and in the "movies" we see the conventional types, and they are usually represented in accordance with these time-honored beliefs.

Whether different proportions of the face have or have not any significance, there is one way in which the human countenance certainly expresses mental differences, and that is through its fluctuating expressions. There is perhaps no branch of knowledge which a human being begins to study so early in life as facial expression. Little babies soon know the difference between a smile and a frown. An intelligent dog will watch its master's face for every change of mood, hanging on the slightest indication of approval or encouragement. The knowledge of the meaning of the face is very important, since the need for the commendation of one's fellow men is almost universal and begins very young, for it harks back to earliest origins. Indeed the desire to be well thought of by the other members of one's own circle is a curious human peculiarity and is almost a prime distinguishing mark between men and brutes. It is probable that not many of the lower animals care at all what the others of their species think of them. Running horses and trotting horses very likely have something of this feeling. They appear to exhibit pride and emulation. So do fox hounds; and perhaps all the gregarious animals have in a crude way the basis for the evolution of this important

NOSES OF NINE GREAT MEN

Is intellectual superiority associated with a large or long nose? The pictures above constitute a random sample from a large collection of photographs of great men of history classified into three groups according to nose-size. Nos. 1 to 5 show long or large noses; they are respectively Paschal (1), LaFontaine (2), Cuvier (3), Michel de L'Hospital (4), Voltaire (5). The next two have been placed in the middle grade; they are Captain James Cook (6), and Arago (7). Numbers 8, Boileau, and 9, Talleyrand, are rare examples showing small or short noses. (Fig. 4.)

human attribute. Man, in one form or another, is always seeking glory,—the boy on the ball field, the child in attracting the attention of "grown ups," the college man in athletics, the mature man in business or professional success.

CHARACTER IN THE FACE

Habitual facial expression, such as comes from chronic gloom, seriousness on the one hand, or constant smiling on the other, doubtless causes wrinkles and permanent marks on the face, which in time give an indication of character or disposition. Firmness of will, and habits of concentrated thought are probably to a great extent shown in the eyes and mouth. But here we enter

Profile of Idealized "Average Man." (Fig. 5.)

unsurveyed fields. There is something in all these attributes, but the actual localization and the analysis and measurement of the significant peculiarities remain for future research to determine.

Physiognomy of expressions is one thing, and physiognomy drawn from proportions of the features is another. While no one doubts that expressions of the countenance are usually of some significance, there are many keen observers, more or less professionally engaged in the study of faces, such as portrait painters, sculptors, photographers, anthropologists and psychologists, who doubt if the *proportions* of the face are of any real significance. They believe the exceptions to any rules are too frequent for generalizations.

My own belief is that, by and large, most people look their parts, and furthermore if the method of scientific induction be applied much can be learned from a systematic study of facial proportions. There are, doubtless, exceptions to any rules, but these, if not too numerous, do not invalidate the conclusions. The whole question hinges on the numerousness of the exceptions, or in other and more scientific words, on the *existence of correlations.*

For about twenty years the present writer has been in the habit of collecting, from time to time, pictures of people out of newspapers, magazines and books, as well as engravings and photographs from painted portraits. Out of all this collecting certain general impressions have arisen, but only a few of these have as yet been put through systematic tests. Already the conclusion has been reached that there has taken place a genuine evolutionary change within the last four hundred years in the proportions of the upper part of the face. Some discussion of this question (with a few illustrative portraits) is to be found in the JOURNAL OF HEREDITY for May, 1919.

TWO PROFILE HEADS OF IDEALIZED "AVERAGE MEN" SHOWING AVERAGE PROPORTIONS

What does the "average man" look like to you? Has your conception been formed from your ideals or from the men whom you actually meet in everyday life? Most of us have usually regarded the average man "as something very fine." (Fig. 6.)

THE SIZE OF THE NOSE

The present article will deal solely with the nose, especially with the question whether or not intellectual superiority is usually associated with a large or long nose.

If the size of the nose is in any way correlated with intellectual superiority then the greatest men in history ought to exhibit noses measurably larger or longer than the average. The correlation might be true all through the scale of intellectuality, but it would be more difficult to measure it and prove it when close to the average, since the differences would be smaller.

With an idea of making a beginning on this problem, a large number of portraits of famous men in different fields of activity, and in different eras, have been put through some systematic tests. The first group examined happened to be a collection of portraits of eminent astronomers published in "Stars and Telescopes," a Hand-Book of Popular Astronomy by Professor David P. Todd (Boston, 1901). Judging from these pictures, I should say that the following astronomers, mathe-

maticians and physicists had noses approximately as in the list below:

	Nose
Copernicus	large
W. Herschel	average
Fraunhofer	long
Delambre	large
Hansen	average
Delaunay	average
Halley	large
Kirchoff	long
Helmholtz	average to heavy
Oppolzer	small
S. J. Perry	average
Tycho Brahe	large
Kepler	large
Newton	long
Euler	large
La Grange	long
Gauss	long
Airy	large
Gassendi	long
C. H. F. Peters	long
Cassini	long
B. Peirce	long
Le Verrier	long
Adams	long
Tisserand	large
Mary Somerville	long
Watson	rather small
Olbers	long
Arago	long
Kaiser	average
Caroline Herschel	rather large
Maria Mitchell	rather large
Chladni	long
D. Olmsted	long
Winnecke	small or average
W. C. Bond	average
Kant	long
La Place	average
Lord Rosse	large
Heis	long
Argelander	average
B. A. Gould	long
Schönfeld	average
Bessel	long
C. A. F. Peters	small
Brünnow	average
Glydén	very large
Struve	average
Dawes	average
Doppler	long
Secchi	average
Henry Draper	average or small
J. Herschel	long
R. A. Proctor	average
Lamont	average
Huygens	average

There are 34 with large or long, 17 with average, and five with short or small noses. The large or long noses are more numerous than the other two grades added together. This was confirmed by the independent judgment of another person, the check figures being 31-22-3.

CHECK OPINION

Own Opinion	Large or Long	Average	Small or short	Totals
Large or Long	26	8		34
Average	5	12		17
Small or Short		2	3	5
Totals	31	22	3	56

The correlation between the two independent judgments is shown in the squares above. There are 26 instances in which the nose seemed large or long to both observers, twelve cases in which it seemed average to both, and three cases in which it seemed small or short to both. It will be noticed that there are no cases in which a nose was judged large or long by one, and small or short by another. The scattering instances of slight disagreement in classification are shown in the figures 5, 8 and 2. To physical anthropologists accustomed to measuring shapes of heads with accurate instruments (brachycephaly, etc.) the idea of measuring the features of the face by general impressions may seem unsatisfactory; but it appears from the data presented in this article that such a method is capable of yielding orderly and consistent results. If this method can be used in physiognomy it means that rapid progress can be made towards at least first approximations in evaluating the relationships that do exist, as well as in demonstrating those which do not.

While it is easy to measure head-forms among large numbers of the general population, it is not so easy, with instruments, to measure the size of the nose in proportion to the size of the

face, or measure the proportions of the various features to each other,—mouth, eyes, upper lip, chin, etc. Furthermore, if we wish to study the faces of "great men" it is more difficult still to go about the world capturing "great men" and measuring their noses. There are never many really great men alive at any one time, but there have been a good many men in the world's history acknowledged as great, and these have nearly always left their portraits behind them. So if there is any way of using these painted records, abundant material is placed at once at our disposal. Also we have the modern photographs of recent and living men, who are among the most eminent of their time. These can be compared with groups of men a little less eminent, and the latter with other groups less eminent still, until the true average or mediocre class is reached.

The second random test happened to be taken from a work called "Orators of England" edited by Guy C. Lee, (2 vols., Putnam, 1902). These appear to me to be classifiable as follows:

	Nose
R. B. Sheridan	average
Francis Bacon	large
Sir John Eliot	long
Thomas Wentworth	average
Oliver Cromwell	large
Sir Henry Vane	long
Heneage Finch	large
Robert Walpole	average
W. Pitt (Chatham)	long
Earl of Mansfield	long
E. Burke	long
W. Pitt, Jr.	average
Charles James Fox	large
Macaulay	average
Lord Erskine	long
Canning	long
Sir James Mackintosh	small
Sir Robert Peel	long
Lord Brougham	large
Lord Lytton	long
Disraeli	long
Gladstone (at 69)	large
Gladstone (at 31)	large

This is a list of very famous men indeed. At least thirteen of the twenty-two are so famous as to have been heard of by all educated English speaking people, and that means a very great distinction, as there are probably not as many as three hundred persons in the whole world's history whose fame is great enough to meet that test.[1] R. B. Sheridan, Francis Bacon, Cromwell, Walpole, Chatham, Burke, W. Pitt, Jr., Charles James Fox, Macaulay, Peel, Lytton, Disraeli, and Gladstone are the thirteen whom I presume would mean at least something to every educated English or American person.

My own estimate shows, out of a total of twenty-two, sixteen with noses large or long, five average, and one small or short. The check opinion gives 15, 7, 0, and is confirmatory. The large or long are twice as numerous as the other two grades.

The next test is taken from Vols. 5, 8, 9 and 10 of the same work: "Orators of Modern Europe" and "Orators of America." The lists follow.

"Orators of Modern Europe," Edited by Guy C. Lee. N. Y. and London—1902. (Putnam):

	Nose
Lamartine	long
Mirabeau	average
Vergniaud	small
Robespierre	average
Danton	average
Bonaparte	long or average
Chateaubriand	average
Kossuth	average
Mazzini	long
Gambetta	large

"Orators of America," 1910. 3 vols., Edited by Guy C. Lee:

	Nose
Hamilton	long
James Otis	average
John Dickinson	long
John Hancock	average
Patrick Henry	long
Edmund Randolph	average
Samuel Adams	large
John Witherspoon	long
George Washington	large
Henry Lee	average
Daniel Webster	large
John Q. Adams	long
Fisher Ames	long
Thomas Jefferson	long
William Wirt	long

[1] Statement based on experience in presenting lists of famous men to groups of friends and acquaintances.

Henry Clay	large
William Pickering	large
John Randolph	average
Thomas Benton	large
John C. Calhoun	average
Edward Everett	average
Rufus Choate	long
Charles Sumner	long
Stephen A. Douglas	average
Wendell Phillips	long
W. H. Seward	large
Robert Tooms	average
Jefferson Davis	average
Abraham Lincoln	large
Alexander H. Stephens	average

Here the ratios are 23 long or large, 16 average, and one small or short. The check opinion is 22-17-1. The names are not quite so eminent as those from England and the ratios of long and large against the other two are not quite so weighty; but the figures are not large enough for this to be worth more than a suggestion. One thing these tests demonstrate is that the method itself is sound. They show that two persons can look over a series of portraits and (without one knowing what the other has done) receive very similar impressions.

The next test is taken from nineteen portraits of modern American "captains of industry." All but about two of these are well known to everyone.

"Millionaires and Kings of Industry" by J. Burnley, 1901.

	Nose	
A. Carnegie	large	photo
J. D. Rockefeller	average	engraving
P. D. Armour	small	engraving
W. A. Clark	long	photo
Jay Gould	long	photo
C. M. Schwab	average	photo
C. T. Yerkes	long	photo
J. P. Morgan	large	photo
Sir Hiram Maxim	long	photo
G. M. Pullman	large	drawing
C. R. Flint	small	photo
Thomas Edison	long	photo
W. Cramp	long	engraving
James J. Hill	large	photo
James G. Bennett	large	photo
Claus Spreckels	long	engraving
John Wanamaker	average	drawing
Henry Clews	long	photo
Frederick Pabst	average	photo

It may be noticed that one of those whose nose is adjudged small is certainly not as widely known as nearly all the others.

The ratios are thirteen large or long, four average, and two short or small. The check opinion gives 11-7-1. This collection is interesting as exemplifying more modern processes of representation. It is difficult to say just where these men should be rated in comparison with the astronomers, orators and statesmen given in the foregoing tests; but it does not matter for the purposes at hand. They are certainly a representative group and, as far as their own fields are concerned (practical invention, organization and business enterprise), they are very much more eminent than the thousands of others in the same fields who are what may be called "successful" or "distinguished." They are certainly very widely known and "famous" in the dictionary sense of the word. Whether they are more meritorious than others not so widely known, or whether they are really more intellectual or not, may be a matter of debate. But if we can show that the lesser sort of men in their own department of activity have, on the average, noses less large than they, it is indicative of *something*. It cannot be mere chance.

"Who's Who in America" has been much used in sociological studies. Such a list, containing as it does about 20,000 names, gives an average eminence well above mediocrity yet well below "celebrity," "world-eminence," "greatness" or whatever word is chosen for your one man in a million or more. There are no portraits in "Who's Who in America," but the Canadian Who's Who, which bears the title "Who's Who and Why," is replete with portraits. As the total population of Canada is only about seven millions and this book is about half as large as the American "Who's Who," it is fair to say that the standard of inclusion is there lower, but this is rather an advantage than otherwise. The Canadian work contains a very high proportion of the Scotch race, and a good many of French and Irish origin, so that for some purposes it might lead to wrong conclusions, but probably not in this inquiry. An ex-

amination of these and other portraits has confirmed the supposition quite definitely that men of moderate distinction do not as frequently as very great men possess noses that are strikingly large or long. All the portraits under the initials A, B and C have been classified, as in the three accompanying tables, and it can be seen that they confirm each other, so that it does not appear necessary to carry the investigation into D, E, F, etc. The effect of picking out the surnames that are not strictly Anglo-Saxon in origin and dealing only with the Anglo-Saxon does not alter the conclusion. In the table for the totals, letters A, B, C, we see the distributions: first opinion, 52-167-45, second or check opinion, 74-151-39. These become for strictly Anglo-Saxon names, 34-109-26, and 51-93-25. The weights are all in favor of the large or long, first number, as against small or short, third number; but the first number is never equal to the sum of the other two, as was the case among the "great men."

A glance at the Chart (Fig. 7) shows two types of lines. All those pointing upward at the center, making a sort of roof-like, or mountainous structure, depict the percentages of the three classifications from the Canadian Who's Who, letters A, B and C. The continuous lines are from opinion No. 1; the dotted lines from opinion

Check Opinion

Own Opinion	Large or Long	Average	Small or short	Totals
Large or Long	8	2		10
Average	8	17	3	28
Small or Short		1	3	4
Totals	16	20	6	42

LETTER A

Check Opinion

Own Opinion	Large or Long	Average	Small or Short	Totals
Large or Long	17	9		26
Average	16	56	9	81
Small or Short		13	13	26
Totals	33	78	22	133

LETTER B

Check Opinion

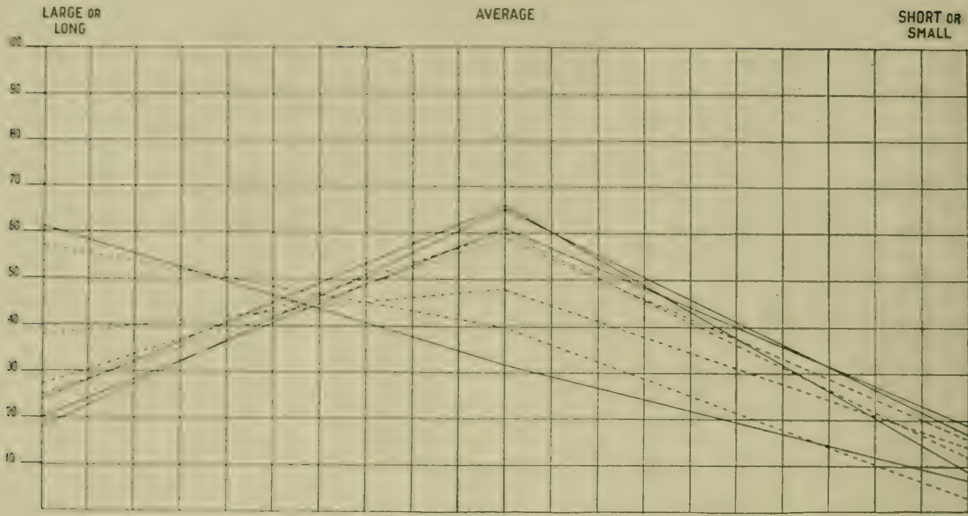
Own Opinion	Large or Long	Average	Small or Short	Totals
Large or Long	14	2		16
Average	10	42	6	58
Small or Short	1	9	5	15
Totals	25	53	11	89

LETTER C

Check Opinion

Own Opinion	Large or Long	Average	Small or Short	Totals
Large or Long	39	13		52
Average	34	115	18	167
Small or Short	1	23	21	45
Totals	74	151	39	264

TOTAL LETTERS A, B, C
in Canadian "Who's Who."



RELATION OF FAME TO NOSE SIZES

The two lines which slope downward from left to right show the distribution of nose sizes among the so-called "great men" of history. The lines that point up in the middle show a different distribution. The latter are adapted from the Canadian "Who's Who." The figures at the left are percentages. (Fig. 7.)

No. 2. The second type of line is like a long sloping roof, high at the left and low at the right. This depicts the percentages from the distribution among the first 147 so called "great men,"—astronomers, mathematicians, orators, statesmen, and great captains of industry. The two opinions agree very closely and give for the "great men" a preponderating weight to the long or large-nosed type—greater than the sum of the other two. The first opinion gives in percentages 61-32-7; the second opinion gives 57-40-3.

Another test was then made by a somewhat different method. The basis of the test was a group of photogravure portraits cut out of current popular magazines. These were taken at random consecutively. All pictures were included, except a very few that were too small or too vague. They were then classified into the three grades. The number of large or long noses came out thirty, the number of average 64; and the number of small or short was ten.

Now which of these three nose groups contained the greatest proportion of eminence? In this instance I have not put the question of eminence, greatness or intellectual superiority to any strict tests, but have made the test into being widely known or "famous." Out of the first group thirty, "large or long" I submit the following thirteen names as being famous or at least widely known in the United States. They are arranged in the accidental order of their inclusion: Lord Strathcona, Senator Gorman, Brander Matthews, George Randolph Chester, Lord Bryce, Goldwin Smith, Sir William Ramsay, Dr. Morton (Demonstrator of anaesthesia, by ether), Mr. McClure (of *McClure's* Magazine, etc.), Senator La Follette, Senator Quay, G. Marconi, Rudyard Kipling.[2]

Out of the sixty-four in the group of average noses the following are submitted as famous names, or at least widely known in the United States: Gilbert Chesterton, Sir George Darwin, Theodore Roosevelt, A. Lawrence Lowell, Lord Reading, Robert Lansing, Rev. "Billy" Sunday, Joseph Conrad, Mark Hanna, George Harvey, Vilhjālmur Stefansson, George Westinghouse.

Here there are twelve names, but

[2] Kipling is on the border line as to size of nose.

they are out of sixty-four instead of thirteen out of thirty.

I do not print the names of those less well-known. There are seventeen in the group "large or long," and 51 in the central group. It is quite possible, indeed probable that some of those omitted from the famous list should be included; but I am sure that there are not more than seven such in the middle group who would if included raise the number to twenty instead of thirteen. But even with these included, the large-long nosed fraternity would beat the averaged nosed people in point of fame. There are furthermore, on the more liberal basis of what constitures fame, at least three from the "large-long" group who must be added. There is in the group of ten small nosed men but one single instance of a very famous man. This exception is Lord Lister. Some might call his nose average, but he is placed among the small nosed group, and the benefit of the doubt may be given to an opponent of the present theory.

Another way of testing this problem is to make a list of the very greatest men in all history, in point of fame, and then examine the portraits of as many of them as possible. Here is a partial list. All these are among the most eminent men who have ever lived. There can be no doubt about their fame. Whether they be "great" or not is another matter. For instance people might dispute as to whether Napoleon should or should not be called "great," but no one can dispute the fact that he is eminent in the sense of attracting a tremendous amount of interest, occupying great space in the shelves of libraries, and time in the thoughts of men. These names are part of a list of preëminent men (no longer living) which I am preparing by the objective methods of historiometry. There is no bias in it one way or another towards this test, so it does not matter just how the list is being made.

LARGE NOSES OR LONG NOSES:

Descartes, Luther, LaFontaine (Fig. 4), Fenelon, Paschal (Fig. 4), Cuvier (Fig. 4), Renan, Ampere, Tasso, Meyerbeer, Newton, Van Dyck, Copernicus, de Musset, Goethe, Liszt, Heine, Pasteur, Colbert, John Fox, Calvin, Titian, Tintoreto, Aritino, Lamartine, Gerson, Helmholtz, Kepler, Kant, J. Herschal, F. Bacon, Cromwell, Pitt the Elder, Burke, C. J. Fox, Peel, Disraeli, Gladstone, Gambetta, Alexander Hamilton, Washington, Webster, Thomas Jefferson, Lincoln, Pasteur, L'Hospital (Fig. 4), Hayden.

AVERAGES NOSES:

W. Herschel, La Place, Pitt the younger, Macaulay, Bonaparte (or long), Kossuth. Bismark, Hugo, Brantôme, Mozart, Wolsey, Lafayette, Voltaire[3] (Fig. 4), Dumas, Moliere, Beethoven, Turenne, Racine, Byron, Robespierre, Cavour, Franklin, Thiers, Fulton, James Cook (Fig. 4), Gluck, Corneille, Arago (Fig. 4).

SMALL OR SHORT NOSES:

Murillo, Danton, Lister, Boileau (Fig. 4), Beranger, Talleyrand (Fig. 4).

This list is merely a fragmentary one, but the great preponderance of the first group over the sum of the other two makes it highly confirmatory of all the previous tests.

Still another test was made from some entirely different data where classifications according to intellect had already been made for an entirely different purpose. My publication "Heredity in Royalty" 1906 contains sixty portraits of adult males suitable for inclusion in the present research. These were graded for intellect in a scale of ten, ten being the highest and one the lowest. Those from seven to ten are, in the combined opinions of historians, superior to those in five and six, which in turn may be called the average types of royalty, and are superior to those in grades one to four. A test made by classifying these por-

[3] Some portraits make Voltaire's nose long, see illustration.

traits according to three grades of size of nose does show a slight relationship, in conformity with the other results here given, but the correlation is a small one (about $r=.10$) and the probable error necessarily large, since the total number of cases is small, being only sixty-nine. The distribution is forty large or long noses, twenty-four average and five small or short. It has always been my impression from the time I first formed a collection of engravings and photographs of royalty, some fifteen or twenty years ago, that their noses were longer than the average. A long nose, a prominent under jaw, a finely modeled mouth, "cupid brow" as it is called, thick in the center and pointed or dimpled in the corners, eyes rather near together and nose delicate at the top, the whole face long and narrow, constitute the general facial characteristics of this special breed.

The distribution of nose-sizes given above bears out, as far as this one point is concerned, a hitherto vague and immeasured impression, and if the noses of royalty are larger or longer than those of the middle and lower classes it confirms, as far as it goes, my contention made in "The Influence of Monarchs" (1913) that royalty as a group taken through the ages has been distinctly superior in natural intellectual capacity to the average of their subjects.

WHAT CONSTITUTES THE "AVERAGE MAN"

This leads to a discussion of what constitutes the "average man"; and before taking up the question of the size, shape and significance of the nose of the average man, it is absolutely necessary to pause, and ponder on some hitherto but little recognized facts.

Clerks, salaried men, school teachers, small-town doctors and lawyers, farmers and shopkeepers are often spoken of as forming the middle class; but these people really do not belong to the *middle* class in the sense of representing the average or most numerous class in the community. They are really considerably above the middle or average, which, in the social scale, is occupied by that vastly more numerous class, the laboring class. These alone, if all the skilled and unskilled artisans be included and added to the number of strictly unskilled laborers, make a total so great as necessarily to establish the average. This "average man" whom until recently we were wont to regard as something very fine, we now know, thanks to the army tests, and other mental age tests, to really possess an intellect of about the mental age of a full grown boy. The mental age of fourteen is as high as the average man climbs.

The reason why we should expect more, is interesting to consider. It is probably not gained from the opinions of people whose business in life is to employ and direct labor. Their conversations on this point are not complimentary. Complaints are always heard of their difficulties in finding such qualities as ambition, mental energy, and efficiency. Yet the average man believes that the "average man" is "just about all right" or "quite the proper thing." The truth of it is that the printed or spoken expression "average man" conveys a imaginary ideal that is entirely at variance with reality.

This is partly due to the influence of the newspapers. They cater to the general public, and consequently tend to create an idealized and mythical being who really scarcely exists. This imaginary man, who is supposed to be so frequently seen, but really is so rare, is given form and color in our imagination, not only every day through the press, in the writings of reporters and editors, but the multitudinous sign advertisements that greet the willing or unwilling eye at every turn tend to implant forever in the memory the well balanced type of countenance. Whether our ideal citizen be seated at his breakfast table ordering his patent breakfast food with his pretty wife and nice children, or putting on collars or underwear, he is

always a finely proportioned being both in face and figure, so here, there, and everywhere, the delusion is conveyed and multiplied that the good looking man is the average man. This is not at all true, and one way to prove it is simply to look at people *separately*, one after another, and do a little mental arithmetic.

By taking a number of photographs of people in precisely the same position and over-imposing one upon another, the well known composite photograph is made. But the typical or usual human being is not a composite. Very few people look at all like a composite photograph. Each taken separately varies, more or less, some in one feature, and some in another. Everyone looks different from everyone else, as everyone knows; but how many people have ever thought how astonishingly variable the faces of the people one passes on the street really are? Most people do not look at each face separately, but if every single face is scrutinized separately and mentally recorded, the truth of this general variability, in other words, general ugliness, becomes obvious. This can be done on a not too crowded thoroughfare, in a trolley car, or railway station. The present writer has whiled away many an hour in this lazy, but not unprofitable occupation of looking at people separately, instead of collectively. One of the best opportunities in the world for seeing what the average man really looks like comes once a year on Labor Day, when, for anthropological instruction, men are selected, classified and labeled. Let anyone of intelligence, education, and maturity stand on the curbstone as a Labor Day parade swings by, and look at each single face with an idea of mentally adding up the total number of faces that approximate the composite face of the idealized working man—such a face for instance as one sees in drawings marked Labor. Sometimes he is shaking hands with conventionalized Capital, always a stout gentleman in silk hat, and formerly with side-whiskers. Sometimes he is quarreling with said stout gentleman, in which case neither party is a subject for flattery from the artist's pencil, but the true standard figure, the one that remains in the mind, is always the idealized or composite, not the true or usual.

To test this, let the reader turn to the first popular magazine at hand and go through the advertisements or illustrations. The present writer did this after writing the above sentence, and the accompanying cut (Fig. 5) was the first one found. It shows the point very well. Here we have a well balanced and rather attractive face' the nose average or slightly long, straight, well formed and thoroughly in harmony with the other features. The second and third pictures found are also reproduced (Fig. 6). They are the two symbolic figures of labor illustrating an article on the conditions of labor. Naturally these are idealized and rendered attractive, almost refined in expression. They are here placed face to face and the rest of the picture is omitted.[4]

Of course, it cannot be said that faces like this do not occasionally exist in the world of reality, but they are certainly rare. Their rarity can only be appreciated by one who seeks to find them either on the street or at some other spot where genuinely average men can be seen in numbers.

The person who searches for facial beauty in crowds, either of men or women, will, according to his standards, probably find one face in from ten to twenty, not that will satisfy, for that is another story, but that will conform to standard proportions. In other words more than nine-tenths of the faces one passes on the street have some feature radically wrong. It may be the nose, it may be the mouth, lips, chin, etc. The reason for dwelling on all this is, that there is a sort of paradoxical statement true of the face of the average man. In one way his features are average in another way not. The forty Canadian soldiers (Figs. 8-10)

[4] All three pictures are from Hearst's International Monthly.

CANADIAN SOLDIERS

The soldiers in this and the two following illustrations were photographed by a well-known Canadian photographer while they were on their way overseas. They naturally came from all over Canada, and are representative men. The pictures were selected at random from a very large collection, and out of a group of forty-one, those shown above have been adjudged by the classifiers to have one of the frequent attributes of mental superiority—a nose longer or larger than the average. If, therefore, any reader sees his own picture here towards the head of the list, he cannot take offense! (Fig. 8.)

show this variation, although they are doubtless selected for physical fitness.

Let us limit our discussion to the nose, by way of illustration. If we examine a large number of faces, or photographs of the truly average class, say wage-earners who in 1913 earned about two to three dollars a day, and in 1919 about five or ten, we will find a very great variation in shapes and

AVERAGED SIZED NOSES

These pictures (1-27, Figs. 8, 9, 10) are arranged in the order of the sizes of their noses according to the combined opinions of ten different people. Only the first seven were adjudged long or large. (Fig. 9.)

proportions of the features. But if we classify the noses alone, by the method of general impressions, into three grades, just as we have done for the celebrated, famous and distinguished, we find the large or long-nosed variety comparatively rare, somewhat rarer than the small or short, and much rarer than the average.

The first random test made on the first material available happened to be on a group of faces or employees in a large department store in Montreal (Scroggie's, 1914). Out of thirty-five men, middle aged and young, five appeared to belong in the large or long group, twenty in the middle, and ten in the small or short. The inde-

AVERAGED SIZED NOSES

These photographs and those on the preceding pages were taken at random to get a comparative idea of the average nose of the average man. But these were picked men who enlisted in the early years of the war and many are decidedly above the true average. Numbers 28 to 40 of the small or short nosed group are not here reproduced. (Fig. 10.)

pendent check opinion gave three, thirty, two. These persons it must be remembered are somewhat above the true median class of society.

The second test was also made on men probably slightly above the average. This has been developed into a series of check tests and merits detailed description. J. E. Livernois, Ltd., one of the oldest photographic firms in Canada, took a very large number of photographs of enlisted men, in the early years of the war, without charging any fee for the sittings, and with the

privilege of reproducing and distributing to newspapers and magazines. Of this large collection I ordered forty chosen at random by Mr. Livernois. I told him I wished to make a study of faces but did not tell him of any theories that I had in mind, or of any of the tests. He took these pictures from his collection one after another, just as it happened to be easy for him to find a negative, and have it printed, therefore the forty Canadian soldiers ought to be a good random sample. They came from all parts of Canada, and were on their way overseas. The forty proved to be forty-one, as one accidental duplicate got included, which was not discovered until after some of the tests were made; but this has been allowed to remain in the collection, as it is amusing to see how often people put the same face in two different classifications.

Ten persons, some more or less expert in the art of judging faces, or trained in habits of scientific observation, have classified these forty-one pictures putting long *or* large noses in one pile, short *or* small in another, and reserving the middle pile for all those that did not strike the eye as belonging in either of the two outer groups. No observer was aware of the classification of any other observer, as the record marks were placed on the backs of the photographs.

These tests show that whereas there is considerable variation as to individual pictures selected for the three grades, the proportions in the end are sufficiently uniform to satisfy the purpose at hand.

Even for the individual pictures selected, there is good and significant correlation between the judgments of any two observers. Roughly these correlations are about r = .20 to r = .50.[5]

Here are three specimens, in the accompanying squares, of my own first classification compared with the first three other independent judgments.

Opinion of A. E. W.

Own Opinion	Large or Long	Average	Small or Short	
Large or Long	3	2	1	6
Average	7	8	9	24
Small or Short		4	7	11
	10	14	17	

r = .39

Opinion of W. W. C.

Own Opinion	Large or Long	Average	Small or Short	
Large or Long	3	3		6
Average		19	5	24
Small or Short		6	5	11
	3	28	10	

r = .35

Check Opinion

Own Opinion	Large Long	Average	Small Short	
Large Long	5	0	1	6
Average	7	11	6	24
Small Short		6	5	11
	12	17	12	

r = .42

[5] Method of rough approximation, given by Yule, Phil. Trans. A. CXCIV, 257-319.

These are better than the correlation for the two independent judgments regarding the portraits in the Canadian "Who's Who." There it was r=.29 approximately. If the same observer is asked to classify the same material a second time, or a third time after several intervening days, these correlations (between his own successive judgments) will be high, even though he has forgotten the individual faces.

I found my own classifications correlated r=.62 between a first test and a second test taken several weeks afterwards, and r=.60 between the second tests and a third taken a few days later. The first and second classifications made by Mr. A. E. Wiggam gave an approximate correlation of r=.75 and the second and third r=.81. In time, anyone's two judgments would give a correlation approaching perfection, or r=1.00, but that would come about only as one grew acquainted with the faces and remembered where they were put before.

All these correlations have an importance to the science of physiognomy, not because of their accuracy (for they are only rough first approximations) but because they prove that the method of visual judgments may be sometimes successfully employed.

Here the chief interest lies in the fact that every one of the ten observers agreed in making the total number of large or long nosed Canadian soldiers a small number, compared to the sum of other two groups. The figures below show the opinions of the observers.

Twenty-seven of these pictures are here reproduced (Figs. 8-10), they are arranged in the order of the sizes of their noses, according to the combined and averaged opinions of the observers. Four pictures in the middle grade have been omitted merely for convenience in representation on the pages of this journal, and the nine at the extreme end of the small or short nosed group have also been omitted so that no one could possibly take any personal offense at the utilization of this material.

	Large or Long	Average	Short or Small
F. A. W.	6	24	11
A. E. Wiggam	10	14	17
W. W. Churchill Portrait Painter	3	28	10
E. K.	12	17	12
Mrs. Wiggam	5	9	27
M. T.	6	21	14
D. Fairchild	9	27	5
O. Olson	14	18	9
Mrs. Pearl	2	12	27
R. Pearl	4	17	20
Totals	71	187	152
A. E. W. 2nd Test	5	13	23
A. E. W. 3rd Test	10	15	16
M. T. 2nd Test	8	24	9
F. A. W. 2nd Test	7	16	18
F. A. W. 3rd Test	6	24	11

The totals 71-187-152 give, when reckoned as percentages of the grand total, 17.3—45.6—37.1. The inclusion of the five repeated observations does not alter the result even as much as one per cent, and is therefore omitted.

The distribution from the group of Montreal department store employees was 5-20-10 or 3-30-2 with a total 8—50—12. This if in percents is 11.4—71.4—17.1, or in other words the middle group is the largest, and the small or short is next; just as was the result from the combined tests on the Canadian soldiers. The average of these two sets of tests on "average men" is 14—59—27.

Subsequently some tests were made on the photographs in Harvard "Class

Albums" to see if the results would fit with those already obtained, and also to see if there is any marked tendency for the nose to enlarge with age. The data are not sufficient to answer the latter question but it appears that the changes with advancing age are merely in the nature of a greater variability. Probably in some, the nose continues to grow, in others the rest of the face becomes heavy in comparison with the nose. The Canadian soldiers were comparatively young, probably about the age of college graduates. The Harvard photographs, being from a presumably higher selected social and intellectual group in the community, ought to show a higher percentage of large—long and a lower percentage of short—small than the enlisted men from Canada.

From the Harvard Class Album of 1920 I made the ratios 9—34—19 on the first 60. Mr. Wiggam's independent estimate was 29—21—10. The two combined give 38—55—29.

I then went through Report VII of the Class of 1886. Here photographs are given of the students at the time of graduation, and also pictures taken twenty-five years later. I examined the first sixty examples, first the young graduates in turn, covering up with a slip of paper, all the adults, and then repeated the process concealing the youthful likenesses and concentrating on the adults. In this way one can measure a double error. If the nose did not change in proportion to the rest of the face, and if one's judgment were perfect, one ought to pick exactly the same individuals for the three classes (r = 1.00). Even using the same identical photographs, one's second judgment is not identical with one's first. The correlation is, as above stated, about r = .60 to r = .80. As the correlation which I obtained for the Class of '86 was r = .39 approximately, and that for the Class of '87 r = .38 approximately, it would seem that there is a good deal of change in the proportions of the features, but nevertheless there is enough constancy to yield a significant correlation, even after allowing for necessary errors in judgment.

The two squares below show that all figures, from the Harvard tests, fit in about where they should for persons mentally above the level of the "average man" but below the level of the "great man."

ADULTS

AGED ABOUT 47

Students	Large or Long	Average	Small or Short	
Large or Long	10	4	1	15
Average	10	21	6	37
Small or Short		4	4	8
Totals	20	29	11	

Class of 1886
r = .39 approx.

ADULTS

AGED ABOUT 47

Students	Large or Long	Average	Small or Short	Totals
Large or Long	8	6		14
Average	4	31	5	40
Small or Short		2	4	6
Totals	12	39	9	

Class of 1887.
r = .38 approx.

HEREDITY AND PHYSIOGNOMY

All this "counting noses" is not without significance for the science of heredity. Great men, famous men, eminent men, distinguished men, successful men, high average men,—using these terms as a descending series of grades towards mediocrity, are all to a certain extent the product of outward circumstances as well as inward forces predetermined in the germ-cells. It

is usually difficult to prove that any mental or moral peculiarities found in groups of persons selected for study are really due to inherent or germ-cell differences. Most of the alleged evidence on this score is entirely without significance, since it can be turned in one direction as well as another. This is the case even in Galton's famous work "Hereditary Genius," though not in his study of twins. It is the case with Odin's oft quoted work, and with the Jonathan Edwards family, and most of the material contained in the notorious degenerate families, "Jukes," etc. The environmentalists have not been slow in seeing this point.

If, as appears probable, each grade of mental superiority is associated with a little larger facial trait, such as the nose, it is at least difficult to see how favorable home environment, good education, or a good run of luck, could make a man's nose larger.

The growth of the face is like the growth of all parts of the body, controlled to a great extent by internal secretion. We do not know much as yet about the actions of these secretions on growth, but one thing however is quite certain, and that is that no matter how important the glands of internal secretion may be, these glands, in their growth and activity must, *under ordinary conditions*, be themselves determined by heredity. The common facts of every day experience prove it. How else can it be that Chinese look like Chinese and Negroes like Negroes. Not only do the facts of racial resemblance prove that the growth controlling force must be in the chromosomes (since the male can influence it as much as the female) but the common facts of family resemblance prove that smaller facial peculiarities are also highly hereditary, and finally the identity of the facial growths of identical twins caps the climax.[6]

CONCLUSION

So, in conclusion, it seems safe to say that here in the size of the nose is one point where a beginning may be made for a future science of physiognomy. The majority of great men have large or long noses, the remainder nearly always have noses of at least average size. Although many mediocre or inferior people have large or long noses, men of measurable intellectual superiority do (statistically) have noses somewhat larger or longer than the average size. The exception only proves the rule. Only very rarely do we find a great man with a distinctly small or short nose.

Furthermore, each supposedly higher and higher intellectual group is found to be associated with greater and greater nose-measurement.

[6] See Journal of Heredity, "Twin Number," December, 1919.

The Eugenic Prospect: National and Racial, by C. W. Saleeby. New York, Dodd, Mead & Co., 1921, pp. 239.

One knows what to expect in picking up a new volume by Dr. Saleeby, and this one does not disappoint. It shows the fluency, warm-hearted enthusiasm, the lack of documentation, the emphasis on the ego, and the all-embracing definition of eugenics, that have marked its predecessors. The volume is made up of a number of somewhat disconnected essays, which might have been written for periodical circulation. There is no index. Eugenics, as understood in America, is sometimes conspicuous only by its absence. The smoke nuisance, tuberculosis, dietetics, and health centres receive the chief emphasis. One of the most interesting features of the book is the reference to Americans conditions,—an outgrowth of two visits to the United States by Dr. Saleeby in recent years. It is of course gratifying to national vanity to find that he regards us, and our fellow-continentals the Canadians, as years ahead of Great Britain in almost everything that has to do with racial betterment.—P. P.

IMMIGRATION AND THE THREE PER CENT RESTRICTIVE LAW

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THE NEW LAW AND ITS ENACTMENT

The new 3% immigration restriction act was designed to meet post-war conditions which our previous laws were never intended to cope with. It passed both Houses of Congress by tremendous majorities, and, after being "pocket-vetoed" by President Wilson, was again passed by similarly large majorities and promptly approved by President Harding. The backbone of the new law is as follows (Sec. 2):—"That the number of aliens of any nationality who may be admitted under the immigration laws to the United States in any fiscal year shall be limited to 3 per centum of the number of foreign-born persons of such nationality resident in the United States as determined by the United States census of 1910." Eight classes of aliens are excepted from this provision, including "(8) aliens under the age of eighteen who are children of citizens of the United States." Provision is made for the determination of the exact numbers of aliens of the different nationalities who may be admitted. The number of any nationality that may be admitted in any one month shall not exceed 20% of the total number of aliens of such nationality who are admissible in that fiscal year. Preference shall be given, "so far as possible," to wives, parents, brothers, sisters, children under 18 years of age and fiancees of citizens, of those who have applied for citizenship, and of persons eligible for citizenship who were in the service of the United States during the war, and were honorably discharged. Provision is further made for the preparation of rules and regulations necessary to carry the Act into effect, and for the publication of statements showing the exact numbers who may be admitted. The Act continues in force until June 30, 1922.

THE REASONS FOR THE NEW LAW

The enormous majorities by which Congress passed this bill clearly reflected the firm conviction of the great mass of our people that immediate and effective restriction was imperative. There has never been a time in the history of immigration legislation when the popular demand was so widespread and so vehement. The practically unanimous opinion of Government immigration officials and of all unprejudiced experts was that immigration was certain to increase, and increase rapidly, to numbers greatly exceeding those of pre-war days, and that the quality of the bulk of the newcomers would be distinctly inferior. Very important testimony along these lines was received from United States consular officers at numerous foreign ports and submitted by the Department of State to Congress. These reports, coming from many different men, and many different places, are distinctly to be regarded as unprejudiced and authoritative. They practically all agree in certifying that the majority of the prospective immigrants are both physically and mentally undesirable. Such expressions as "physically deficient," "mentally deficient"; "economically undesirable"; "socially undesirable"; "of low standards of living," "not of the most desirable class," occur again and again. Furthermore, numerous competent and unprejudiced observers who had been making a first-hand study of the conditions in Europe fully concurred in the views expressed by our own consular officers.

The predictions made by these various competent authorities have been fully verified. Immigration during the year ending June 30, 1921, exceeded 800,000, almost doubling that of the preceding year. Furthermore, the opinion of those who have had opportunity to observe the new arrivals, and who are unprejudiced and honest in their views, is to the effect that our consular officers and our experts were fully justified in their statements regarding the inferior quality of most—not all—of these people. An immigration official at New York has recently reported that the majority of the aliens now coming in expect to be fruit peddlers, shoe-blacks, soft drink venders and sweat-shop workers (N. Y. Times, Sept. 12, 1921).

THE OPPOSITION TO RESTRICTION

In spite of the extraordinary popular demand for restriction in accordance with which Congress acted, there was insidious, active opposition; thoroughly organized; heavily financed; issuing misleading information; playing upon all sorts of alien prejudices; endeavoring by every possible means to counteract the plain will of the vast majority of the American people. One of the best known and most reliable Washington newspaper correspondents, Mr. Mark Sullivan, writing of the hearings before the House Committee on Immigration (Feb. 7, 1921) said:

> The great bulk of the hearings consisted of testimony from special interests, either racial or business, who opposed the bill strenuously. No thoughtful American, equipped with knowledge of the background, can read the stenographic report of those hearings without being deeply and sombrely concerned.

Still more striking is the evidence brought forward by Hon. John C. Box, of Texas, in the House of Representatives Jan. 8, 1921. Judge Box said:

> Mr. Chairman, recently by a vote of 295 to 41 a bill suspending immigration was passed by this House, in which vote the will of the American people spoke, and party lines disappeared. But powerful influences oppose restriction. Two of these are:
>
> First. A demand by the foreign born among us that their kins-people and racial comrades be admitted freely.
>
> Second. Individual and corporate greed which disregards the present and future welfare of the mass of Americans and their children, because it wants money and power over labor.
>
> The Inter-Racial Council is a mouthpiece of the opposition of these two groups. To it I invite your attention. . . .
>
> The Inter-Racial Council is a concern of some magnitude. Some months ago it had 40 or 50 executives and other full-time paid employees in its offices in New York, and an unascertained number of other agents and employees. It is financed, in part at least, by its industrial or subscribing members, numbering several hundred. The following are some of its subscribing members, whose names I get from its printed literature and from the testimony of Mr. Mayper, its executive secretary:
>
> Phelps Bros. & Co., "owners of an Italian steamship line," the International Mercantile Marine Co., Barber Steamship Lines, Cosmopolitan Shipping Co., Downey Shipbuilding Corporation, France and Canada Steamship Co., Green Star Steamship Co., Pacat Steamship Co., Pacific Steamship Co., Todd Ship Yards Corporation, Standard Oil Co. of New Jersey, Allegheny Steel Co., American Beet Sugar Co., American Locomotive Co., American Woolen Co., Armour & Co., Atlas Powder Co., Chattanooga Coke & Gas Co., Colt's Patent Firearms Manufacturing Co., General Electric Co., Henderson Shipbuilding Co., Hillman Coal & Coke Co., Indiana Pipe Line Co., Inland Steel Co., Kelley-Springfield Tire Co., Lackawanna Steel Co., National Sugar Refining Co., National Ship-

ping Co., New Home Sewing Machine Co., Oliver Iron & Steel Co., Pennsylvania Coal Co., Pennsylvania Coal & Coke Corporation, Pennsylvania Textile Co., Phelps-Dodge Corporation, Southern Cotton Oil Co., Standard Steel Car Co., Studebaker Corporation, Underwood Typewriter Co., Worthington Pump & Machinery Co., Bethlehem Steel Co., Cudahy Packing Co., Dold Packing Co., Du Pont de Nemours & Co., General Motors Co., Libby Mc Neil & Libby, Swift & Co.

These are only a few of the several hundred big financial, industrial and steamship concerns whose money is financing the propaganda of the Inter-Racial Council. It will be noted that many steamship companies are among them. One list of these subscribing or industrial members will be found in the committee hearings of April 22, 1920; another list, containing some names not given in the testimony, will be found printed on the literature of the Inter-Racial Council.

These subscribing members pay annual membership fees amounting to as much as $2,500 for some concerns, and more than that for a few, and smaller sums for each of many others. "It runs from $100 a year to $2500, as an average. A few are larger." (Testimony of Mayper, executive secretary, p. 167.)

The expenditures of the Inter-Racial Council in certain of its activities, which manifestly do not cover all of them, amounted to $213,955.19 for the period beginning March 1, 1919, and ending March 31, 1920. (See testimony, Mayper, p. 167) That was the first year of its existence. Its activities have continued with apparently increased magnitude, but I am without information as to later expenditures.

Mr. Blanton. Mr. Chairman, will the gentleman yield?

Mr. Box. Yes.

Mr. Blanton. Is it any wonder, then that this splendid piece of legislation has been sidetracked and held up?

Mr. Box. It is not any wonder, but it is an ominous thing if the will of the American people is to have to give way to influences like these. Nothing but a sense of duty prompts me to present these facts as they have been disclosed. The statement that I have made is based upon testimony. I have the hearings.

The situation is perfectly clear. Further comment on this point is unnecessary.

THE WORKING OF THE LAW

It was natural that there would be certain difficulties in the early working of the new law, before the exact numbers of admissible aliens from each country could be officially determined. Numerous steamers arrived during the early part of June with aliens far in excess of the numbers which were admissible. Congestion resulted. To each port there had been assigned a percentage based on the usual percentage entering that port. When these numbers had been filled, efforts were made to borrow, from other ports, "rights" to land additional immigrants. There was great confusion. Immigration officials in Washington went to the limit in showing humanity and consideration. Aliens in excess of the June quota were allowed to land under bonds. By Joint Resolution Congress later provided that the excess numbers of any nationality thus admitted should be deducted from the totals of that nationality admissible during the fiscal year beginning July 1, 1921.

But even in the early days of the new law, and all the more since then, the complications and the hardships to incoming aliens have been chiefly due to the disregard of the law by the steamship companies. In the whole history of our immigration legislation, these companies, with rare exceptions, and then usually only when infractions of the law meant payment of fines, have never tried to obey our laws. Their tactics under the new percentage limitation Act have been as usual.

The percentage bill was before Congress, in one form or another, during most of last winter. There never was any doubt that it would become law before summer. Although the exact number of aliens of each nationality could not be officially determined at the moment of the enactment of the measure, the steamship companies had ample time to make plans to meet the new conditions. They were in no sense "caught," as one editor has expressed it. The logical, and the humane, policy on their part would have been to refuse passage to all aliens who might, when the exact percentages of admissible immigrants were announced, be refused permission to land. But these companies accepted as steerage passengers several thousands of aliens who would, beyond a doubt, be excludable. There is little doubt that these excess aliens were shipped with the conviction that the sympathies of "sentimentalists" and of certain Congressmen who are interested in the "foreign vote" would be so aroused that some special provision would be made for the landing of the excess numbers. The steamship companies deserve absolutely no sympathy. They accepted the passage money of thousands of aliens who should never have been allowed to embark. They have no interest in their steerage passengers beyond the receipt of their passage money. The Commissioner-General of Immigration said in Washington on June 10 last that there were then more than 10,000 immigrants in excess of the June quota already on their way to the United States, and *all were accepted for passage after the new law had gone into effect!*

The monthly "immigrant Derby," when, during the last few minutes of each month, incoming steamships race from beyond the three-mile limit to quarantine in the effort to land their steerage passengers in time to have them come within the quota, and the numerous cases of hardship when the excess aliens have to be debarred, could be avoided if all the steamship companies were honestly endeavoring to live up to the law. The trans-Atlantic steamship lines have a system of daily exchange of information as to the numbers of alien passengers who are embarking on their several ships. No excess over the allotted quota need therefore be started on the voyage.

Although practically all of the difficulties, and the hardships to debarred aliens, were due to the flagrant disregard of the law on the part of the steamship companies, the Administration very properly felt that everything possible should be done to save needless suffering of perfectly innocent aliens. Hence, about mid-September, the State Department sent instructions to American consular officers abroad not to visé passports from any country whose annual admission quota to the United States is approaching exhaustion, or has already been exhausted. This should do a great deal to reduce the number of cases of hardship and of disappointment for which, be it reiterated, the steamship companies, not the laws, are chiefly responsible.

PROPAGANDA AGAINST THE NEW LAW

Even before the new law went into effect, a very active press campaign against it was begun. The law has been subjected to an organized attack by "interested" individuals, alien racial groups and hyphenated societies, and certain influential newspapers. All of these are bent on making any percentage limitation scheme appear unreasonable, unjust and inhumane. All of them are, fundamently, opposed to any action on the part of the American Government to protect our country against practically unrestricted and unselected immigration. In the case of influential newspapers which are incessantly attacking the new law it may incidently be noted that they all carry heavy steamship advertising. In the case of other papers also, the motive is plainly that of the pocket-book. Thus, the Bulletin of the Associated General Contractors has said that the effect of the law will be to "prevent the immigration to this country of the most useful class of immigrants—the com-

mon labors who come here to work in the construction industry." The "influences" against restriction have also been very busy in Washington, interviewing Senators and Congressmen, attacking not only the percentage limitation measure but also all restrictive legislation.

The propaganda against the new restriction law has not been confined to this country. In a despatch to the Philadelphia *Public Ledger*, dated London, Oct. 26, 1921, the following statements were made:

> European steamship companies, the traditional enemies of United States immigration restrictions, have started propaganda aiming at the breaking down of the barriers put up by the "3 per cent" law. They hope when the present temporary measure expires, next June, to have so prepared the ground that again they will be in a position to fill the holds of their ships with Europe's surplus humanity and pour it into the United States. This law which limits the number of immigrants to a very small proportion of the number allowed to enter the United States heretofore was a severe blow to the steamship lines, and they fought it hard when it was before Congress. In the days before the war steamships carried thousands of immigrants at approximately $100 a head, whereas now they carry dozens. The loss of that revenue came at a time when the transatlantic passenger business was less remunerative than for years because of the high costs of operating ships.
>
> To get back some of this business the big companies have outlined a plan for a campaign of propaganda, and already have got it working in England. The plans rest on the idea of digging up specific cases of alleged improper treatment of foreigners at Ellis Island and spreading them broadcast in the European press.

The attitude of the steamship companies and of the other influences which are seeking to bring the new law into disrepute has been clearly set forth by Government officials. Representative Isaac Siegel, of New York, wrote to the President in September citing instances of cruelty to aliens which had occurred in the enforcement of the law. President Harding replied as follows: "I haven't any doubt in the world but the enforcement of the immigration laws is working many a hardship. My own distress has been very great over some of the specific instances which have been reported to me. If I have the situation correctly presented, the difficulty must be charged to the dishonest steamship agents who have brought to this country innocent immigrants in spite of our continued warnings during a period of very great leniency. I know how very persistent have been the impositions which have been made on the Government agents who have been disposed to be sympathetic and more than generous in carrying out the law." . . .

Secretary of Labor Davis reiterated the statement by the President that much of the trouble is caused by dishonest steamship agents and that pitiful stories of hardship are being circulated in the deliberate attempt to discredit the law. Assistant Secretary of Labor Henning on Sept. 3, said,

> Unfortunately the law has no teeth, and the only way the offending companies can be punished is to compel them to take back aliens who are not admissible.

That, he added, was being done, the Department "having exhausted its milk of human kindness." Mr. Henning here emphasizes the fundamental deficiency in the law. *It has no teeth.* There is no fine or punishment for the companies which disregard its provisions, nor is the company required to refund the deported alien's passage money. The only way is to compel the companies to carry back, at their own expense, the surplus, and when this has been done in a few hundreds of cases, it is perhaps not too much to hope that these companies will begin to cooperate among themselves. As soon as they do so, the law will prove entirely workable.

Finally, on Sept. 15, Assistant Secretary Henning added,

> Those in control of the flood of aliens coming into this country deliberately exceed the monthly quotas, and depend upon compelling us, with their sob stories and tales of families being separated, to permit the law to be disregarded.

Patriotic Americans, in whose hearts Patriotism is above Pocket-Book, cannot give too much praise to President Harding, Secretary Davis, Assistant Secretary Henning and Commissioner-General Husband, for their firm stand on this whole question of the enforcement of the law. In the face of aggressive, persistent and thoroughly organized opposition on the part of selfish interests, they have held their ground, tempering the enforcement of the immigration laws of the United States with the utmost possible justice and humanity. They deserve well of their country, and they may be assured of the support and high commendation of the vast majority of plain Americans, who are not organized to work for the enforcement of these laws, and who seldom take it upon themselves to make their views known to Government officials, either personally or by writing. The highest commendation is also due to the Senators and Representatives who, in the face of fierce and bitter opposition, heavily financed and thoroughly organized, secured the passage through Congress of the new Act. To Senator Dillingham of Vermont and his supporters in the Senate, and to Congressman Albert Johnson of Washington, Chairman of the House Committee on Immigration and his staunch supporters on his Committee and in the House, the country owes a great debt of gratitude which it will not forget.

THE NEW LAW VINDICATED

The percentage law, in spite of its crudities and of difficulties in its enforcement, has been abundantly vindicated. Immigration was fast assuming its pre-war rate when the new law went into effect. Although it did not begin to function until early in June, the Commissioner-General estimated that it probably reduced immigration in that one month by about 50,000. As one of the Washington correspondents puts it,

> Incidentally, the sudden appearance of unemployment in America illustrates the wisdom of the act restricting immigration, which was passed during the first few weeks of Harding's administration. Otherwise, our unemployment problem might have been greatly increased. Throughout the world great numbers of human beings have been displaced by war and post-war conditions. These derelicts float towards us as inevitably as water flows down hill. There was some degree of truth, although more mere cleverness, in the saying that America was becoming the "cesspool" of the human race. . . . The new law puts a limit, even if only a loose and partial limit, on the number of immigrants who can increase and complicate our unemployment problem.

SUGGESTIONS FOR FUTURE LEGISLATION

The 3% Limitation Act expires on June 30, 1922. What shall take its place? The "emergency" which led to its adoption still exists, and will continue to exist. There is no longer an "emergency." We are facing a permanent condition of rapidly increasing and of steadily deteriorating immigration. And there are millions of prospective immigrants overseas who are simply waiting for the 30th of June, when they will rush in, in a seething, chaotic mob, unless Congress takes steps to stop them.

A calm, unprejudiced survey of past legislation, and of the workings of the temporary 3% restrictive law, leads the writer to the following conclusions regarding the lines along which our new legislation should be planned.

First: The percentage limitation principle, long and strongly advocated by leading authorities, should be made permanent. Whether this should be the present 3%, based simply on the

number of aliens of each nationality in this country, or a somewhat larger percentage, say 5% or 10%, based on the numbers of each nationality who have become citizens, is relatively immaterial. The latter, on the whole, seems the more consistent and more rational plan.

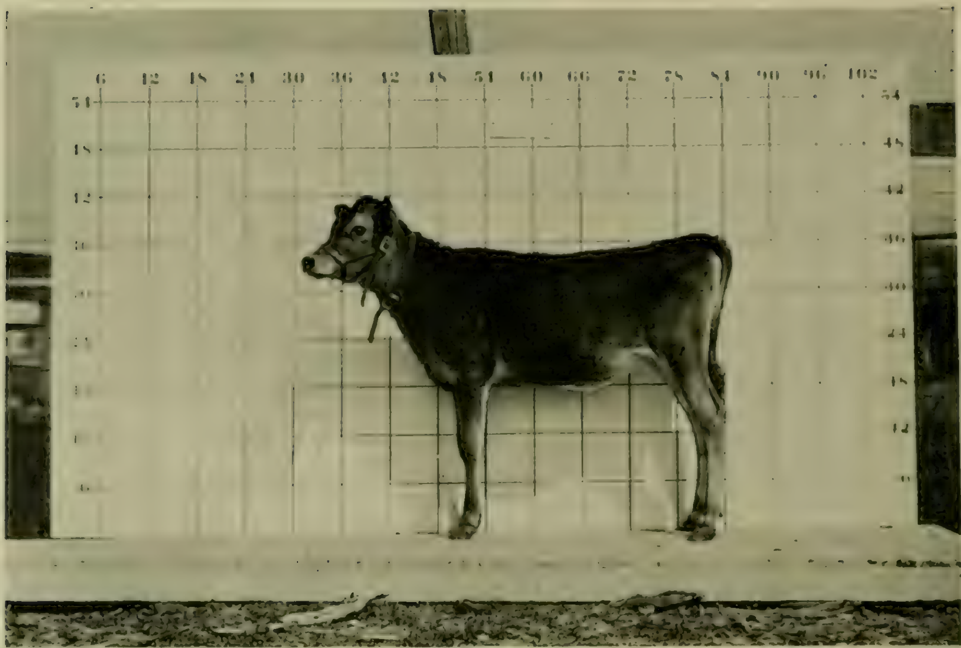
Second: Heavy fines of at least $200 should be imposed upon the transportation companies in the case of every alien who is brought here in excess of the quota, and in violation of the general immigration laws. Such fines would immediately put an end to most of the cases of hardship and suffering which have occurred during the past few months because the present law has "no teeth." It is a very strong argument in favor of heavy fines that, by this means, we can force the steamship companies, without expense to us and with the minimum of hardship to the intending immigrant, to make a careful examination and count of their passengers on the other side, and thus to prevent the embarkation of all aliens in excess of the quotas, and of those who are inadmissible, for any other reason, under our laws.

Third: Every prospective immigrant should have a passport, viséd by an American consul after the alien has been "passed" by an immigration inspector and a medical officer of the U. S. Public Health Service attached, as Vice Consuls, to various consular offices abroad. This provision is embodied in a bill introduced by Hon. Albert Johnson, of Washington, on July 16, 1921 (H.R. 7804). Such foreign inspection would obviously be a wise and humane way of stopping most of the inadmissible aliens before they started on their voyage. This plan would be to the advantage of the prospective immigrant, and it would also be better for the steamship companies, for it would mean that very few rejected aliens would have to be taken back at the companies' expense. Canada has for years eliminated her undesirable immigrants "at the source." Passports would not give the alien the right to land if, after a second examination at our own ports, he were found to be inadmissible. Cases of this sort would, however, be rare. Furthermore, the number of passports issued in each foreign country should not exceed the official percentage quota of that country.

Fourth: Some plan of registration of arriving aliens such as that suggested by Secretary Davis might well be inaugurated. This would not in any way constitute the alien a suspected or an undesirable person, but it would help us in our task of Americanization and of exercising a sort of watchful supervision over our new arrivals.

The logical thing to do is to plan our new legislation along existing lines. Experience has shown that these are on the whole wise, sane and reasonable. (Canada, for example, has, in her immigration laws, closely followed our general immigration law, although she has added many additional restrictions.) With the changes and additions above suggested, certain perfectly definite results would follow, viz., (1) a reasonable restriction, to something like an assimilable quantity, of the number of immigrants; (2) a far more careful selection, and a more effective elimination of the unfit; (3) a very great reduction in the number of cases of hardship now arising when aliens reach our shores only to be deported.

In the light of all available facts, it would seem in the highest degree unwise, illogical and dangerous to embark upon any new and untried schemes of immigration legislation, such as those of putting almost unlimited discretionary powers in the hands of a Commission; of repealing any portion of our general immigration Act of 1917, and of superseding the Chinese Exclusion Act and the "Gentlemen's Agreement" with Japan by a plan for admitting Orientals on any percentage basis.



HOW MUCH WILL A CALF GROW FROM CALF-HOOD TO MATURITY?

This is Valentine Betty, a Jersey calf, photographed in May 1917. The picture below shows her as she appeared in May 1921, indicating at a glance the growth that took place during the four years. It will be noted that the growth is very little in length of legs but a great deal in depth of body. (Fig. 11.)

VALENTINE BETTY AS A MATURE COW

Six calves measured in May 1917 averaged 32.8 inches in height. Four years later they averaged 47.9 inches. The growth of 15.1 inches came from a deepening of the body by 11.1 inches and a lengthening of the legs by 4 inches. (Fig. 12.)

GROWTH OF CALVES

J. J. Hooper
University of Kentucky

HOW much will a Jersey calf grow in length of leg, and in depth of body as it passes from calf-hood to maturity? To secure definite information regarding the growth of calves, I measured six Jersey heifers when they were six months old and again when they had matured into four and a half year old cows. The six heifers varied from two months to seven months of age when I first measured them, but averaged six months old. The last measurement was taken when they were four and one-half years old.

I find that they average 32.8 inches high as calves, and 47.9 inches high as mature cows. They gained 15.1 inches in height. I find that 11.1 inches of the gain in height came from a deepening of body or chest, and 4.0 inches from a lengthening of the legs. From an inspection of the table it will be observed that the calves grew in length of front legs as much as two to five and one-half inches, but it will be observed that their growth in height came principally from deepening of the body.

Also I would call attention to the fact that the heifers were wider through the thurls at five months of age than through the hips, but after they had become mature cows they were wider through (or across) their hips, than across their thurls.

After the calves had been measured notes were made as to what kind of mature cows they would grow into. In checking over the notes after the heifers had matured into four year old cows, these prophecies were found remarkably correct in most instances regarding both the form of udder and of body conformation. But in one instance a nice heifer began to sway in her back at eighteen months of age, and became very swayed as a two-year old. We find that the udder and teat formation is fairly evident at five months of age.

The measurements of cows and calves are as follows:—

Average of 6 Jerseys	Heifers 5 months old, May 1917	Cows 4½ years old, May 1921	Increase inches	Increase per cent
Ht. over withers	32.8	47.9	15.1	46
Ht. to chest	17.8	21.8	4.0	22
Depth of chest	14.9	26.0	11.1	80
Width of chest	7.8	14.1	6.3	81
Width of hips	8.3	18.8	10.5	120
Width of thurls	8.8	16.3	7.5	85
Width of barrel	10.9	26.3	15.4	140

An Old Problem Restated

THE RELATION BETWEEN RELIGION AND SCIENCE: A BIOLOGICAL APPROACH, by Angus Stewart Woodburne. The University of Chicago Press, 1920, pp. 103.

Speaking more precisely, Mr. Woodburne might have called his approach psychological rather than biological. He holds that science and religion have often been thought to be antagonistic, because the latter claimed a supernatural origin; but that as a fact both of these "attitudes" are purely human in genesis, having their foundation alike in the human instincts. Science he considers to be an explanatory attitude, while religion is an evaluatory attitude. On this basis, he thinks there can be no conflict of interests, but rather there must be a co-operation of the two types of attitude, to the end that human life may be made fuller, richer, and more satisfying.—P. P.

THE "PEACH-ALMOND" HYBRID

Leonard Coates
Morganhill, California

THE so-called "Peach-Almond" has been known in California for 70 years. Prof. E. J. Wickson has endeavored to trace its origin, and found that it was first heard of in the nurseries of W. B. West of Stockton, one of our pioneer nurserymen, in the early fifties. And further research developed the fact that Rivers of England speaks of showing it to Darwin who said it had long ago been described and catalogued in France.

The acompanying illustrations show characteristics of fruit and give evidence of vigor of tree. The leaves and wood resemble a very lusty almond. The fruit, for several months, looks like an immature, growing peach, until the pericarp splits open, revealing the pit, which is more like that of the peach, but smoother. The pulpy pericarp is sweetish and insipid.

My own first acquaintance with the "Peach-Almond" was in 1877, in the

Uafa Valley, where one tree existed in an orchard of mixed fruits. This tree was subsequently grafted over, as being worthless, commercially, but not before I had saved the seed for use in the nursery I was starting. The tree appears, generally in groups of two or more, in many orchards throughout California. This may be through, or as a result of natural hybridization, distributed from the nurseries in mistake for budded trees, or through some careless hand cutting of buds in an orchard row, and taking some from a chance "Peach-Almond" because of its extreme vigor, and, no doubt, before it had time to exhibit itself as in the illustration.

Apart from all this, I have always found it a most excellent stock for peaches, almonds, and most plums, possessing much more vigor than either peach or almond seedlings.

The tree illustrated is three years old top-grafted on almond, growing on a hillside where no irrigation is available.

THE CHERIMOYA TREE ON ITS NATIVE HEATH

In southern Ecuador (Loja province) the cherimoya tree occurs as an indigenous species, sometimes in such abundance as to form small groves. From this region it has spread, through the agency of man, to many other parts of tropical America as well as to Australia, Ceylon, Madeira, and numerous other places in the Old World. The wild trees here shown are growing in a small ravine near the Hacienda La Capilla, fifteen miles south of the town of Loja, at an elevation of about 5,000 feet. The peculiar leaning habit **of the tree is characteristic of the cherimoya. (Fig. 15.)**

THE NATIVE HOME OF THE CHERIMOYA

Wilson Popenoe
Agricultural Explorer, U. S. Department of Agriculture

"THE pineapple, the mangosteen, and the cherimoya," wrote the botanist Berthold Seemann, "are considered the finest fruits in the world. I have tasted them in those localities in which they are supposed to attain their highest perfection—the pineapple in Guayaquil, the mangosteen in the Indian Archipelago, and the cherimoya on the slopes of the Andes—and if I were called upon to act the part of a Paris I would without hesitation assign the apple to the cherimoya. Its taste, indeed, surpasses that of every other fruit, and Haenke was quite right when he called it the masterpiece of Nature."

This superb fruit (*Annona cherimola*), well known and highly appreciated from Mexico to Chile and Argentina, as well as in a few regions of the Old World, has received, in recent years, the attention of North American horticulturists. The climate of southern Florida has proved too tropical for the production of good fruit (for the tree, though a native of the tropics, grows in those regions only at considerable elevations, where the climate is much cooler than on the seacoast); but in southern California excellent cherimoyas have been grown, and it is likely that in future years fruits produced there will make their appearance in the markets of the eastern United States.

A NATIVE OF ECUADOR AND PERU

The abundance of cherimoya trees in many countries of tropical America has made it somewhat difficult to fix with certainty the native home of the species. The plant often escapes from cultivation and sometimes (as in parts of Mexico and Guatemala) becomes so thoroughly naturalized as to deceive local botanists into considering it indigenous. The principal cause of the uncertainty which has always existed regarding this subject, however, may be sought in the circumstance that the region generally considered by the best authorities as the native home of the species has been visited by very few botanists. Alphonse DeCandolle, in preparing his classical work, the "Origin of Cultivated Plants," was unable for this reason to say more than the following: "I consider it most probable that the species is indigenous in Ecuador, and perhaps also in the neighboring part of Peru." A botanical specimen obtained in Ecuador by the late Edouard André helped him to reach this conclusion. "André gathered," he says, "in a valley in the southwest of Ecuador, specimens which certainly belong to the species as far as it can be asserted without seeing the fruit. He says nothing as to its wild nature, but the care with which he points out in other cases plants cultivated or perhaps escaped from cultivation, leads me to think that he regards these specimens as wild."

More recently, W. E. Safford of the U. S. Department of Agriculture has re-sifted all the available evidence, and has written that "DeCandolle is in all probability correct in attributing it to the mountains of Ecuador and Peru. The common name which it bears even in Mexico is of Quichua origin . . . and terra-cotta vases modeled from cherimoya fruits have been dug up repeatedly from prehistoric graves in Peru."

While working in Ecuador in 1921, I came upon the following passage in Theodor Wolf's excellent work[1] on that country: "In the mountains of Loja Province—for example, between Loja and Malacatos, at an elevation of 1,800 to 2,000 meters—I have seen the cherimoya, in a wild state, forming small groves."

[1] "Ecuador," published at Leipsig in 1892.

WILD CHERIMOYAS FROM THREE DIFFERENT TREES

Three or four centuries of cultivation seem to have produced very few changes in the size and character of the cherimoya. The three fruits here shown were taken from wild trees in the vicinity of the Hacienda La Capilla, south of Loja, Ecuador, and are not different in any important characteristics from the fruits of cultivated trees in Mexico or Guatemala. Variation in size and form of fruit, and in the character of the surface, is common in all cherimoyas, both wild and cultivated. (Fig. 16.)

DIFFICULTIES OF TRAVEL

Having a deep interest in this tree—an interest which extended to the question of its native home—I was stimulated by Wolf's note to undertake a trip into the region mentioned. This involved a month's time and not a few hardships, for southern Ecuador is one of the most remote and inaccessible regions on the Pacific side of South America. It may be entered by one of two routes: from Guayaquil by water to Santa Rosa, and thence across the mountains on muleback; or from Huigra (on the Guayaquil and Quito Railroad) by muleback through Cuenca and Loja. By either route one has an overland journey of five or six days before reaching Loja, the town nearest the region in which the cherimoya is found. I chose the southern route,—that by Santa Rosa. Leaving this village, I rode with the overland mail to an American mine at Portovelo, near Zaruma. This trail is notorious throughout Ecuador, and has been so since Wolf's day (the late eighties). After leaving the coastal plain and beginning the ascent of the first range of the Andes, it is the vilest, save one, which I have ever traveled. During the long rainy season the mule-trains work it into a series of horizontal ridges and intervening ditches filled with water: these are called *camellones*, and are, evidently, the product of that peculiar instinct which leads a mule to step always in the tracks of his predecessor.

Those few American naturalists who have traveled in Ecuador recently will bear me out when I say that Portovelo is the one oasis in a vast desert of muddy roads, poor food, and bad sleeping accommodations. From here I traveled four days more to Loja, being forced to make a long detour because of the bridge across the river at Portovelo having been carried away by high water. Nowhere along this route can one obtain a decent place to sleep, and it is difficult, even, to obtain so much food as a couple of eggs or a few bits of yuca (cassava). The wise traveler will, therefore, leave Portovelo with his saddlebags well stocked.

IN SEARCH OF THE WILD CHERIMOYA

Once in Loja, I made the acquaintance of Enrique Witt, who told me that the cherimoya groves mentioned by Wolf had been largely destroyed in recent years, but that there were in the same general region numerous others, the best of which were perhaps those of La Capilla. I therefore struck off toward the south, soon finding myself in a country as desolate and lonely as any I have ever visited. Far ahead, across the distant mountains, lay Peru, and, much nearer, the valley of the Rio Catamayo. After a short day's ride, I reached the small farm known as La Capilla, swung my hammock between the rafters of the house, begged the loan of the kitchen fire to prepare myself a bowl of pea soup, and prepared to spend the next day among the *chirimoyales*, as the cherimoya thickets are here called. Before reaching this spot, I had seen along the roadside many scattered trees of this species, and a few small clumps of them. I began to feel, therefore, that I was at last to see the cherimoya on its native heath. How, I asked myself, will the fruits of these trees compare with those of our cultivated cherimoyas? This was the question which most interested me. The cultivated cherimoyas have had the benefit of more or less conscious selection extending over a period of at least two centuries. Will there, I continued, be any visible differences between the fruits of these wild trees and those of our cultivated ones?

In a canyon near La Capilla—and later elsewhere in the same general region—I came upon many groves of cherimoyas, growing under conditions which left no doubt in my mind as to the indigenous character of the species. Here we have a district very sparsely peopled, with few routes of travel, in which the cherimoya occurs profusely in nearly all of the *quebradas*, or small canyons. It seems incredible that it should be an escape, for the trees are vastly more numerous than I have ever seen them in Central America, and in addition, they are not limited to the vicinity of roads or trails as in the latter.

In addition to the groves of La Capilla, I have seen cherimoya trees, in great profusion, on the slopes above the Rio de las Playas (farther down stream called the Casanga), between Cangonamá and Catacocha. This region is not far from La Capilla, and like the latter is almost within sight of Peru. Since there is no change in the character of the country, nor, I believe, that of the vegetation at the boundary line between the two republics, I consider it altogether probable that the species occurs in the extreme northern part of Peru; and in this I am supported by the Sres. Carlos and Ramon Eguiguren of Loja, who assure me that they have there seen small groves of wild cherimoyas.

The zone of elevation in which the tree occurs is narrow. Wolf observed it between 5,800 and 6,500 feet; I have seen it as low as 4,700 feet, though not in great profusion, and as high as 6,000 feet. The larger groves seen by me were all at elevations between 5,000 and 6,000 feet.

TREES ABUNDANT IN VALLEYS

The situations in which the trees are most commonly found, so far as I have observed, are the slopes or sides of small ravines, and the occasional bits of alluvial land which are formed in the narrow mountain valleys. The valley soils seem to be preferred by the cherimoya, and such lands also appear to produce the largest trees; nevertheless it is not rare to find scattered specimens on clay slopes of somewhat rocky character. The climate of this part of Ecuador is warm, as indicated by the elevation, yet it is not hot as it is in the coastal lowlands. Sugar cane is cultivated (though not extensively), and around the occasional huts of the natives there are orange and avocado trees, bananas, and a few food crops such as corn and yuca (*Manihot utilissima*). The climate is less moist than that of Loja. There is a dry season, rather severe I imagine, which extends from May or June to October or November.

Cherimoya trees here reach 25 feet in height, occasionally 30 feet or slightly more. Often they divide at the ground and have three or four main stems. There is a fungous disease which attacks a great many of the trees, forming round black spots on the leaves, at length causing them to turn yellow and fall.

The fruits ripen from October to March, the season being at its height in January and February. It is said that the trees fail to bear when there are no rains in October. Their productiveness is probably not great, even under the most favorable conditions of weather and soil. Experience with cultivated trees would lead us to expect that such would be the case. Because of the immense number of trees in this region, and the very few people present to consume the fruit, cherimoyas are extremely abundant in the months of January and February, and the hogs are said to fatten upon them. The largest and best specimens are sent to Loja for sale; the remainder, with the exception of the few which can be consumed by the people, are either eaten by the hogs or allowed to rot on the ground.

CULTIVATED FRUITS NOT MATERIALLY DIFFERENT FROM WILD ONES

The immature fruits are commonly attacked by an insect whose white larvae, about one-fourth of an inch long, burrow through the flesh and eventually out through the skin, leaving a round hole in the surface. Only a few ripe fruits were available at the time of my visit, but there was an abundance of immature ones. I was interested to see if the various types which we recognize in cultivation, accordingly as the surface is smooth or rough, were to be found upon the wild trees. They were. In the numerous specimens examined, the surface was most commonly smooth, with the carpellary areas marked by raised lines, but there were also, in limited numbers, most of the other types with which we are familiar in California. I did not find the mammillate form. The type

THE VALLEY OF THE RIO MALACATOS

This small valley of southern Ecuador, along with others in the same general region, is the native home of the cherimoya. The valley floor lies at an elevation of about 5,000 feet above the sea; the mountains on either side reach up to 8,000 or 10,000 feet. The climate is dry and moderately warm, the soil mainly clay, with alluvium along the river and in the ravines which lead down from the adjacent slopes. On this alluvial soil, and occasionally on the clay slopes, are many wild cherimoya trees, scattered or in small groves. (Fig. 17.)

in which the carpellary areas are slightly sunken (forma *impressa* of Safford) and the umbonate form with short, thick, rounded protuberances (forma *umbonata*) were both present. At maturity, most of the fruits are small, and many are of irregular form, just as occurs with cultivated cherimoyas. Large fruits are said to be produced occasionally by these wild trees. One which I saw weighed over a pound, and specimens between three and four pounds in weight are said to have been found, though I do not have this on very good authority. In quality, these wild fruits seem to be just as good as the cultivated ones produced in other countries.

It seems, therefore, that the cherimoya has undergone practically no change in cultivation. This is not perhaps so remarkable as it appears at first glance. When we remember that most of the tropical fruits cultivated in America have been propagated only by seed, and that they have been subjected to very little selection—indeed, in most cases they are not even given systematic cultivation—we can scarcely expect that the mere act of transplanting the cherimoya from Ecuador to Mexico or Guatemala would produce notable changes in the character of its fruits.

There are many similar cases in the tropics. The sapote (*Calocarpum mammosum*), a common wild tree in northern Guatemala, is cultivated in numerous countries. I have seen fruits produced in the virgin forests of Guatemala which were practically as good and in no wise different from those of cultivated trees in Cuba and Mexico. The cashew (*Anacardium occidentale*), as produced by wild trees on the Brazilian coast, is fully as large a fruit and not in any way different from the cultivated cashews of many other countries. It may be said, indeed, that the majority of tropical fruits are still wild species, for man has done very little to improve them, except in those cases such as the pineapple and the banana, where the species are propagated by suckers.

TUBERCULOSIS AND HOW TO COMBAT IT, by Francis M. Pottenger, M. D. C. V. Mosby Co., St. Louis. 1921. Pp. 273.

"When Koch discovered the tubercle bacillus in 1882, he supplied the knowledge which exploded the theory of tuberculosis being an inherited disease, and furnished the fundamental facts which proved that it is an infection which takes place after birth."

The author describes the nature of tuberculosis, and gives rules for its treatment which he has found of value during 20 years' experience. It is a book primarily for patients. It is not intended to take the place of a physician, but to supplement his instructions. While many of the rules may already be common knowledge with thoughtful people, the treatise will repay diligent reading, whether or not the reader be a tubercular patient.

On Voluntary Parenthood

CHILDREN BY CHANCE OR BY CHOICE, by William Hawley Smith. Boston, Richard G. Badger, 1920. Pp. 369.

This book is devoted principally to a prolix demonstration of two points: (1) that sex-life in the human species has an "affectional value" as well as a reproductive use; and (2) that it is preferable that children should be born as the result of deliberate planning rather than "by accident." Most persons are probably ready to concede these points without argument; those who are not may find Mr. Smith's discussion of value, in spite of its repetitions and verbosity, although he brings forward no considerations that are not familiar. The argument is not always kept on a sound biological basis, and when it reaches a difficult point the author completely sidesteps. This is perhaps the chief defect of the book, which in general is written in a sensible and wholesome manner.—P. P.

The

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A WILD TEOSINTE PLANT IN CENTRAL MEXICO

In the study of the origin and history of maize or Indian corn, teosinte has, in recent years, come to play an important rôle. It is the nearest wild relative of maize yet discovered, and a possible ancestor of that species. Two types of teosinte have been found in Mexico; one annual, and the other perennial, in character. Assuming that both are descended from a common stock, it seems reasonable to believe that the perennial form most closely approximates this common ancestor. The plant here shown, which is growing beside a small irrigating canal at Anavacuyán, Durango, Mexico, is of the annual type. (Frontispiece.)

TEOSINTE IN MEXICO[1]

The closest wild relative of Maize is Teosinte—a forage plant hitherto known only as an annual. A perennial form discovered in Southern Mexico should prove of value to the breeder

G. N. Collins

Bureau of Plant Industry, U. S. Department of Agriculture

TEOSINTE is the Mexican name of a genus of large grasses (Euchlaena), the only wild plant that has been hybridized with maize. As at present recognized Euchlaena is considered a monotypic genus, all forms of teosinte being referred to the one species, *Euchlaena Mexicana* Schrad.

Before our recent trip to Mexico we were familiar with but two forms of teosinte; first, the teosinte listed by many American seed firms and widely grown in warm countries as a forage plant. In the United States it matures seed only in southern Florida and all the American trade is supplied with seed from a single plantation.

The origin of this type is uncertain. The Florida form appears to be the same as that distributed from France to many tropical countries, and the early records indicate that teosinte was introduced into France from Guatemala.

The form and color of the seed, as well as a number of plant characters, make it an easy matter to separate this variety, which we have called "Florida," from the second form known as "Durango," from its place of origin in the Mexican state of Durango.

The Durango variety was first brought to the United States by Dr. Edward Palmer, the veteran Mexican collector. The original introduction failed to mature seed when planted at Washington and the stock was lost.

A second lot of seed of the Durango variety was obtained from Dr. H. V. Jackson of Durango. Planted in southern California it produces an abundance of seed. So far as known Durango teosinte has not been exploited commercially, except that it was the form from which Burbank derived the variety called "Early Harvest." Dr. Jackson supplied Mr. Burbank with seed of Durango teosinte and in fact sent seed of hybrids between this and maize that may have provided the intermediate forms put forth by Mr. Burbank as demonstrating the evolution of maize from teosinte.

The Durango variety is distinctly more maizelike than "Florida," and the possibility that the distinguishing characteristics of this form might be due to admixture with maize at some remote time made it seem unwise to recognize the two forms as specifically distinct until a study could be made of the conditions under which they grow in a wild state.

Before 1910 teosinte was known only as an annual plant. In that year Dr. A. S. Hitchcock discovered in the State of Jalisco a perennial form of teosinte that propagates itself by rhizomes. All the annual types of teosinte were known to hybridize readily with maize and it was at once appreciated that new forms, of possible economic as well as of great scientific interest, would result if living plants of this perennial type could be obtained and if crosses with maize could be affected.

The unsettled conditions in Mexico made it impracticable to conduct explorations in that country until the past season. In September and October 1921, Mr. J. H. Kempton and the writer visited Mexico primarily for the purpose of procuring living plants and seeds of the perennial form and also to obtain more definite information regarding the distribution and uses of the annual types of teosinte growing in Mexico.

[1] Paper read before the Botanical Society of America, Toronto, Canada, December 28, 1921.

TEOSINTE IN DURANGO

Our first objective was the City of Durango. It was near this city that Dr. Edward Palmer had first collected seed of a teosinte distinct from that grown in the southern states and known as Florida teosinte; and it was also from this locality that Dr. H. V. Jackson had supplied us with seed of this variety since extensively used in genetic experiments and usually referred to as "Durango teosinte."

After a number of unsuccessful trips about Durango, teosinte was found growing wild along the bank of an old irrigating ditch at Alcalde Ranch, Anavacuyán, about 15 miles east of Durango. (Frontispiece.) The plants were growing amid a luxuriant growth of other plants and practically in the water. The other plants were chiefly sedges, grasses and Polygonum. While at this time there was no maize within a quarter or half mile, the locality was one in which maize had formerly been grown. The teosinte plants showed the same diversity of forms and the same evidences of remote hybridization with maize that has been observed in our plantings of Durango teosinte.

We learned that teosinte had been planted about Durango as a forage plant in an experimental way but apparently no one is now growing it. Wherever planted, it reseeds itself year after year and most people who know it consider it a weed to be eradicated and many have the idea that it will cross with maize to the detriment of the latter.

Other expeditions were made to points within ten or fifteen miles of Durango, but the only additional plants of teosinte that were found were two stunted individuals growing in the garden of a Catholic priest in Durango where they had survived from a former planting. It may be concluded that teosinte is a rather rare plant about Durango and that it is known there only as a weed.

TEOSINTE IN THE STATE OF MEXICO

From Mexico City we went by auto to the region of Lake Chalco since this region is mentioned by Lopez y Parra[2] as one in which teosinte grows.

Teosinte was found a mile or so from the town of Chalco on the road from Mexico City. It was growing along ditch banks by the side of a corn field and in barley fields. (Fig. 2.) The plants were small, the tallest not over six feet in height. The small size was due perhaps to the severe competition with other plants. Along the side of the corn field they were in the midst of other grasses, Ipomeas, and other plants. A few individuals were found also as weeds in the corn fields. In two of the barley fields in this locality teosinte was one of the most common weeds.

There were some indications that the teosinte had been hybridized with maize, but this evidence was not so pronounced as the close intermingling of the two species would lead one to expect. No teosinte characters could be detected in the maize, unless branches in the axil of the prophyllum be so considered, and this character is common to all maize of the *Zea hirta* type. The maize at Chalco had red sheaths, few tassel branches, short ear stalks, well-developed tuberculate hairs as well as branches in the axil of the prophyllum. It was in fact typical *Zea hirta* or hairy Mexican, a type of maize known only from the Mexican tableland.

The most pronounced evidence of hybridization was the presence of tuberculate hairs, which were found in all of the teosinte plants examined (Fig. 4); also the leaf sheaths were red. Neither of these characters had before been observed in pure teosinte. The segments of the rachis of the pistillate spikes were often pressed out of line; in some instances they were rather persistent and a few cases of paired seeds were observed, but after all no

[2] Lopez Y, Parra, Rodrigo—El Teozinte, Mexico, 1908.

STAMINATE AND PISTILLATE INFLORESCENCES OF THE DURANGO TEOSINTE

The staminate inflorescence, shown above at the right, is not unlike a corn tassel, but there is little about the pistillate spike (left) to suggest an ear. Nevertheless, it is thought that the annual forms of teosinte (of which the Durango is one) may have originated as hybrids between the primitive, perennial teosinte and maize or Indian corn. (Fig. 1.)

TEOSINTE GROWING AS A WEED AT CHALCO, MEXICO

In certain parts of Mexico teosinte, a possible ancestor of Maize or Indian corn, grows as a weed in and about cultivated areas. The plants here shown are in a barley field near Mexico City. The ground was formerly a lake bed: it has been drained artificially in recent years. (Fig. 2.)

STALKS OF CHALCO TEOSINTE

The sheath has been removed from the specimen on the left, to expose the spikes. It may be seen that the lowest inflorescence is borne at the very base of the branch in the axil of the prophyllum. While this is a universal characteristic of teosinte, it is only in the region of Chalco that maize also produces an inflorescence in the axil of the prophyllum. (Fig. 3.)

plant was found with more than a suggestion of maize characters.

Both the maize and teosinte obviously were flowering at the same time and some explanation seems necessary as to why they do not completely intergrade. Since the evidence indicates a dilution of the teosinte rather than of the maize, the low stature of the teosinte may be a factor. Most of the tassels of the teosinte were borne at or below the level of the ears of maize.

The barley fields in which the teosinte was growing had been planted formerly to maize and it was apparent that the teosinte had volunteered. It was here that the most corn-like teosinte plants were found. No volunteer maize plants were found in the barley, indicating that the teosinte is much more tolerant of competition than maize. In fact, no maize plant could be expected to grow beyond the seedling stage in the presence of so much other vegetation.

Another factor in the failure of maize to volunteer may be the promptness with which it germinates. Maize seeds would, for the most part, germinate in the fall and be killed in the winter. On the other hand there is evidence that the seeds of teosinte require a period of rest before they will germinate. This might account also for the suppression of intermediates and maize-like teosinte plants, the seeds of which would be likely to germinate in the fall and not survive the winter.

The presence of tuberculate hairs and red sheaths in this teosinte is open to a number of interpretations:

(1) Most of the hybridization may be of ancient date and since intermediates would be preserved neither by nature nor man the two original types have been segregated except that characters of no survival value, such as tuberculate hairs and color of the sheath, have persisted in the teosinte; or

(2) The same causes which have favored the development of the color and hairs in the maize may have done the same for the teosinte; or

(3) If, as a result of the greater height of the maize plants, the crossing is teosinte female by maize male and not vice versa, hybridization may take place frequently; but since the hybrid seed would be borne on the teosinte plants it would not be harvested. The first generation hybrids, left to take care of themselves, might be so maize-like as not to survive in sufficient numbers to be observed.

Although teosinte was abundant in this particular locality, its distribution appears to be very restricted.

TRIPSACUM CONFUSED WITH TEOSINTE

Our experience at Coscomatepec, the next locality we visited, demonstrated that great caution must be exercised in accepting the localities that have been assigned as stations for teosinte. Dr. C. A. Purpus had reported teosinte as growing at Coscomatepec, a small town north of Cordova in the State of Vera Cruz, stating that it was there planted as a fodder plant and propagated by cuttings.[3] This novel method of propagation made this station of special interest.

There were persons in Coscomatepec who recognized the name teosinte and confirmed the statement that it was formerly grown as a forage. With the disturbances accompanying the revolution its growth was said to have been practically discontinued. A planting of this forage plant was eventually located in a walled-in garden in the town and proved to be a species of Tripsacum, probably *T. laxum*, a form common in Guatemala. In fact, the more generally recognized name for the plant at Coscomatepec is "*Zacate Guatemalteco*." According to the most accurate information we could obtain, Tripsacum was introduced originally into this region from Guatemala.

Thus it appears that the name teosinte is applied sometimes to Tripsacum. Before flowering, there is a superficial resemblance between Euch-

[3] Letter to D. G. Fairchild.

DOES WILD TEOSINTE SOMETIMES HYBRIDIZE WITH CULTIVATED MAIZE?

On the extreme left is a stalk of maize from Chalco, Mexico, and next to it one of annual teosinte from the same region. The covering of hairs on the leaf sheath of the latter is a new character in teosinte, and may have arisen through crossing with the hairy maize which is cultivated in this part of Mexico.

On the right is a well-developed pistillate inflorescence of Chalco teosinte. The triangular segments are not true seeds, but joints of the rachis in which seeds are embedded. (Fig. 4.)

PERENNIAL TEOSINTE, A POSSIBLE ANCESTOR OF MAIZE OR INDIAN CORN

It is believed that this type, which was found in the state of Jalisco, Mexico, is more primitive in character than annual teosinte, and that the latter may, in fact, have resulted from a cross between the perennial form and cultivated maize. (Fig. 5.)

laena and Tripsacum, but as soon as the inflorescences appear the two genera should not be confused by the most casual observer. We found later that the application of the name teosinte to Tripsacum was wide-spread in Mexico; for example, near the Ampara mines in the State of Jalisco there is a section of the country known by the name of "Los Teosintes." The natives say that the place is so called because of the abundance of teosinte growing in that locality. Here again the plant to which they refer proved to be Tripsacum, and no Euchlaena could be found in the region.

This confusion of common names makes it necessary to view with suspicion any localities assigned to teosinte that are not substantiated by herbarium specimens or adequate descriptions of the plant.

The fact that a broad-leaved Tripsacum is known as "*Zacate Guatemalteco*" and that it was introduced into at least one locality in Mexico from Guatemala makes it necessary to question the statement that Euchlaena is native in Guatemala.

PERENNIAL TEOSINTE

We next proceeded to Guadalajara to attempt the location of the perennial teosinte collection by Hitchcock in 1910. The locality given on the specimens in the National Herbarium, collected by Hitchcock, is "in prairie, along railroad, one mile south of the railway station of Zapotlan, Jalisco." We could locate no place in Jalisco named Zapotlan until an old map gave us the clue. Zapotlan had been changed to Cuidad Guzman. This city lies in a level valley surrounded by mountains on all sides except the south. The valley is perhaps twenty miles long by ten in width and is one large corn field divided by the railroad right of way and the narrow lanes that bound the fields allotted to the individual peons who grow the maize on shares. It seemed a most unpromising place to seek teosinte. The right of way where it had not been mowed recently was covered with a rank growth of sun-flowers, bidens, and other plants among which were a few grasses. Distances on the railroad were marked in kilometers and although there seemed little hope of finding teosinte in this tangled vegetation we began a very careful search after passing the first kilometer. At two and one-half kilometers, or almost exactly one mile, we found the plant we sought—a few small clumps in a part of the right of way that had been mowed recently.

That we were able to rediscover this plant at all is a striking demonstration of the importance of careful, systematic work and a tribute to Dr. Hitchcock's acumen as a collector and his painstaking accuracy in recording localities. We spent several days examining the country about Guzman, both in the mountains and in the valley, but were never able to find teosinte more than a short distance from the original station. Opposite the point where it was first found it spreads into the corn field as a weed, but is most abundant in one of the narrow paths leading through the field. An area one mile square would include all the plants we were able to find.

It should be noted that nowhere in Mexico did we find teosinte, either annual or perennial, as a wild plant in uncultivated areas. Its natural habitat seems to be flat, alluvial lands and since these are the very areas most desirable for agriculture, it is perhaps not to be expected that the plant would be found remote from cultivated regions.

Another important factor which tends to restrict teosinte cultivated areas is the promptness with which it is eradicated when the land is subject to grazing. Both teosinte and Tripsacum are sought eagerly by grazing animals with the result that teosinte is restricted to the cultivated areas that are protected artificially from domestic animals while Tripsacum is confined to steep, rocky slopes and deep ravines where it is out of the reach of grazing animals.

THE PRIMITIVE FORM OF TEOSINTE

In this illustration are shown, natural size, a leaf, staminate inflorescence, and pistillate spikes of perennial teosinte from the state of Jalisco, Mexico. A comparison of these spikes with those of the annual forms shown in Figs. 1 and 4, brings out the fact that the segments of the latter are definitely triangular, while those of the perennial type have the lateral apex of the triangle somewhat flattened, as in Florida teosinte. (Fig. 6.)

SPIKES OF PERENNIAL TEOSINTE CONTAMINATED WITH MAIZE

Here are shown, natural size, pistillate spikes of the perennial form of teosinte from the state of Jalisco, Mexico, which have been contaminated by maize or Indian corn. A sure indication of maize ancestry is the crowding of the segments, and the consequent forcing of the joints into a zigzag position. (Fig. 7.)

The development of rhizomes was a constant feature in all the teosinte at Ciudad Guzman. (Fig. 5.) The plant is undoubtedly perennial and distinct from all the forms of teosinte previously known.

Further explorations are needed, especially in Guatemala, before deciding whether the Durango and Florida forms should be placed in separate species, but the perennial form is undoubtedly a new species.

In the form of the seed the perennial teosinte more nearly resembles Florida teosinte than that found at Durango or Chalco. (Fig. 6).

One plant was found with double female alicoles, a persistant rachis, and seeds protruding slightly beyond the glumes, a combination of characters not uncommon in the second generation of maize-teosinte hybrids. (Fig. 7.) The discovery of this plant showing maize characters makes it seem certain that this new teosinte will cross with maize and produce fertile hybrids. Although teosinte was growing among the maize plants and the two species had flowered simultaneously, this single plant was the only evidence of hybridization that could be found.

By reason of its perennial nature, this new species of Euchlaena is less maize-like than the annual forms of teosinte and at once suggests that the latter may have arisen through the hybridization of a perennial teosinte with maize. The evidence for this view is altogether too meager to more than raise the question, but it should be recalled that in the only instance that teosinte was found in a region where the maize possesses distinctive characters, these same characters were found in the teosinte.

Fortunately it should be possible to give a definite answer to this question in two or three years. If forms closely resembling the annual types of teosinte can be developed from hybrids between perennial teosinte and maize, there would seem little reason to doubt that wild types of annual teosinte have arisen in this manner. On the other hand, if the annual character cannot be separated from the other teosinte characters the theory must be abandoned.

CONCLUSIONS

Teosinte was found growing wild in three distinct localities: annual forms in Durango and the State of Mexico, and a perennial form in Jalisco.

Although occasionally cut for fodder, teosinte was nowhere found to be cultivated. On the other hand, it was not found as a wild plant outside of cultivated areas.

The natural habitat of all forms appears to be level, alluvial lands, not subject to extreme drought. The grazing of animals restricts it to protected areas.

None of the forms of teosinte are common or widely distributed. In the regions where they occur, they attract little attention and then only as a weed in maize fields.

Although teosinte and maize were growing in close proximity, there is little evidence of natural hybridization.

The name teosinte is frequently applied to species of Tripsacum—a fact that has led to much confusion regarding the natural distribution of teosinte.

There is a perennial form of teosinte that differs from all previously known types which are annual by the production of rhizomes.

In its seed characters the perennial form of teosinte resembles the cultivated teosinte of Florida more closely than it resembles the annual varieties of Mexico.

If all the forms of teosinte are descended from a single stock, it seems reasonable to believe that of the known forms the perennial species most closely approximates this common ancestor.

Since the annual forms of teosinte occupy a position between perennial teosinte and maize and since at least one form of annual teosinte is distinguished from the others by characters which it shares with the maize of the region in which it grows, it is suggested that the annual types of teosinte may have originated from hybrids between perennial teosinte and maize.

THE CELL MECHANISM

A Review of Sharp's Cytology

THE present condition of cytology as one of the most actively developing biological sciences is indicated by the appearance in little more than a year of three new text-books on the subject, two from England and the American one which is the subject of this review.[1] The source of this increasing interest in morphological cytology evidently lies in its inter-relations with genetics and with cell physiology.

Professor Sharp's book is well planned and modern in its view-point. It gives an adequate historical background and extensive bibliographies; each of the general subjects treated is followed by a bibliography which should render available a complete list of titles to anyone who followed up those given. It is efficiently indexed, all generic names in the index are followed by some word showing the general systematic position of the organism. This is a feature which will be found very convenient. The book is well balanced; some 214 pages deal with such subjects as "Protoplasm," "Metaplasm," "Polarity," "Plastids and Chondriosomes," etc.; 86 pages are devoted to the chromosomes; and the last 104 pages to the theories and laws of heredity and the relation of the latter to the chromosomal mechanism.

A number of the text-figures are diagrams which show the behavior of the chromosomes with the greatest simplicity. Indeed, to the reviewer, certain diagrams like those on pages 228 and 229 where, for the sake of clearness, the second maturation division is not represented, seem to have gone too far in this direction. Other diagrams are excellent, e. g., the two on page 341 which give the parallelism between the distribution of an allelomorphic pair of Mendelian characters and of a homologous pair of chromosomes.

For the majority of the readers of this Journal, the parts dealing with the chromosomes and heredity are the ones of most interest and, so far as the principles involved are concerned, they are presented in such a way that it would seem that a person with no technical training in either cytology or genetics could read the book and grasp them. However, the real usefulness of the book depends on its value as a cytology text and a close inspection from this standpoint leaves one disappointed in several respects. A first edition of a book of such wide scope almost inevitably contains some errors. This one presents a rather large number, and it seems necessary to consider these at some length because this work comes nearer to meeting a definite need for a text-book of cytology than any other available.

The chief difficulties will be considered under three headings with brief examples.

1. A lack of clearness and precision of expression. Usually an experienced cytologist could arrive at the meaning, but a thoughtful beginning student will meet considerable difficulty with a sentence such as this, pp. 351, "If—the mutation is such as to result in a recessive character, this character does not manifest itself until it meets a similarly mutated gene in the homozygous individual." In this brief sentence, there is evidently confusion as to character and gene, while the meaning of the latter part of the sentence can only be surmised. Perhaps one of the ideas is that when two gametes each bearing similar genes for some character meet they give rise to an individual homozygous for that character.

[1] Introduction to Cytology, by Lester W. Sharp, Ph.D. pp. 452 with 152 text-figures. New York, McGraw-Hill Book Co. 1921.

A somewhat different type of lack of precision is shown in numerous instances and may be illustrated by this sentence from p. 344, "The 12 pairs of chromosomes in man may in the same way form several million such combinations." Some 18 pages further on, one learns that there is considerable disagreement as to the number of chromosomes in man. This lack of care in making unqualified statements is one of the most disconcerting features of the book.

2. Lack of Accuracy: On page 362, Fig. 141 we find certain figures copied from Wieman marked as follows:—"A, primary spermatocyte, negro; B, same, white." The first is a growth period nucleus, the second a first spermatocyte metaphase, consequently the very striking difference in their appearance can scarcely be attributed to the fact that one is from a negro and the other from a "white." In Wieman's plates, they are correctly designated.

Another example which the reviewer hesitates to mention is in regard to the recognition of the sex chromosome; credit is rightly given to Henking (1891) for the discovery that a body which he thought to be a nucleolus or "chromatin body" was distributed to ½ of the spermatozoa; then follows this statement (p. 358), "It was subsequently shown by Paulmier (1899), Montgomery (1901), and de Sinety (1901) that this body is not a nucleolus but an extra or accessory chromosome," and finally, "It was at once suggested by McClung (1902), that the accessory chromosome in some way determines sex." As a matter of fact, the term accessory chromosome was introduced by McClung in 1899 and the suggestion as to the probable function of the chromosome was made by the same author in 1901.

Inaccurracies of the kinds referred to so far will doubtless be largely removed from later editions. A more serious feature remains to be considered.

3. The interpretation of chromosomal behavior at critical stages. On lines of work in which the author has not engaged the presentation of the facts and the arguments pro and con are usually well given, while conclusions based on his own observations are certainly not applicable to a great deal of material which might be used in a cytological course. To be specific, his description of the longitudinal splitting of the chromosomes by the formation of a series of vacuoles in the prophase, while coinciding with a great deal of botanical literature on the subject, is in conflict with what clearly takes place in many animals where each chromomere divides. Sharp (p. 155) discredits the existence of chromomeres on the basis of his own work and considers the chromatic thread as homogeneous. The generally accepted view on this subject may perhaps best be indicated by a quotation from Agar's recent cytology. He says in regard to chromomeres (p. 134), "This condition, which forms one of the most characteristic sights met with by the cytologist, can be illustrated by reference to almost any work dealing with mitosis, whether in the soma, germ track of during meiosis. . . . It is equally characteristic of animals and plants." Since genetical evidence leads us to expect just such a linearly arranged series of units as the chromomeres in fact furnish, they are of considerable importance both from the standpoint of heredity and cytology.

Another position taken by Sharp which is not satisfactory to one familiar with animal cytology is in regard to the maturation phenomena—again a stage of prime importance from the standpoint of heredity. In common with the majority of botanists, Sharp describes the chromosomes of the first maturation division as bivalent in structure. The outstanding characteristic of the prophase of the first maturation division is the tetrad or chromosome composed of four equal parts due to the longitudinal splitting of the synapsed homologues. Sharp states (p. 234), "The diakinesis stage is terminated by the dissolution of the nuclear membrane and the formation of the spindle, upon which the bivalent chromosomes,

whether secondarily split or not, now become arranged. Because of the peculiar form and consistency of the heterotype chromosomes the mitotic figure presents a striking contrast in appearance to the ordinary figure of somatic cells." This "striking contrast," however, depends wholly upon the fact that the chromosomes are "secondarily split," that is, that they are tetrads and not dyads. The writer has had enough contact with botanical material to be confident that this statement is true for plants as well as animals. A number of the more recent plant cytologists have recognized the tetrad nature of the chromosomes of the first maturation division.

The manner in which the chromosomes split, the existence of chromomeres, and the structure of the first maturation chromosomes are all matters of prime importance in cytology and genetics and since this is a book which, on account of its many excellent qualities, is sure to be largely used as a text-book, it becomes a clear duty to indicate these weaknesses. However, a capable instructor with suitable material for demonstration may easily show the real conditions and thus turn these points to advantage in teaching students independence of observation.

In conclusion: this book seems adapted to meet the needs of several classes of people, among them the general reader seeking to enlarge his field of knowledge and the practical breeder who wishes better to comprehend the physical mechanism through which he obtains his results. The beginning student of cytology should find it interesting because of the emphasis which is placed on the problems which are now attracting most attention. The instructor who wishes a text-book will find the subject presented in a well-rounded manner. While to the zoological cytologist, the book will be especially useful since it stresses the views of the botanists and makes their results more readily accessible.—*E. Eleanor Carothers.*

The Improvement of Citrus Fruits

That the study of bud variation in plants, frequently thought of as the harmless amusement of amateur horticulturists, has led to an increased production of citrus fruits valued at more than a million dollars annually, is a fact that should be of more than passing interest to the members of the Genetic Association.

In a recent paper,[1] Mr. A. D. Shamel calls attention to the importance of this method of improving our agricultural plants and shows that a surprising number of the leading varieties of most of our perennials have originated as bud sports or mutations. That Mr. Shamel himself has taken a leading part in this work and that it is chiefly through his efforts that the value and importance of bud selection now is being appreciated, is modestly concealed. The paper gives a brief but explicit description of the methods that have been followed in the bud selection work with citrus fruits.

Mr. Shamel also announces that preliminary work with sugar cane in Hawaii gives definite indication that a corresponding improvement in that crop also may be brought about by applying similar methods. The results of bud selection in a great variety of plants are brought out in a vivid and striking way by the 41 beautiful full-page illustrations.—G. N. C.

[1] "The Improvement of Plants Through Bud Selection," A. D. Shamel, Experiment Station of the Hawaiian Sugar Planters' Asso., March, 1921.

THREE NEW MUTATIONS IN OENOTHERA LAMARCKIANA

Interesting plant forms found in a strain of evening primrose obtained from Professor De Vries. These mutants, showing new variations in leaf structure, pigmentation of stalk and buds, and color of flowers afford further material for analysis of this important group.

George H. Shull
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Any one engaged extensively in breeding Oenotheras discovers many new as well as old mutant types. The less striking of these are identified with difficulty and it does not seem desirable to encumber the literature with distinctive names for them. Now and again, however, a form appears which has such definiteness that it may be profitably used in breeding experiments, and references to these are facilitated by assigning to them names in harmony with the names already published for the other mutant types.

Among the mutations which have appeared in my cultures there are several which have exceptional interest and these are being used in numerous breeding experiments. Since they are destined to enter to a greater or less extent into the future literature of the group and since they have a certain amount of interest in themselves, quite independently of the experiments in which they are being employed, it seems desirable to give them a publicity which will serve to validate the names which are being used in the notes on their genetical behavior.

Since 1905 I have been keeping, in addition to many other Oenothera cultures, a strain of cross-bred *Oenothera Lamarckiana* which originated from nine original rosettes collected for me by Professor de Vries in the same field at Hilversum, Holland, from which he had secured the material for the initiation of his own Oenothera cultures about twenty years before. These cultures have been maintained, year after year, by crossings so arranged that every progeny in the strain has had four distinct grandparents. The three mutations here described have all arisen in this cross-bred strain.

Oenothera Lamarckiana mut. *funifolia* mut. nov.

DESCRIPTION OF STRUCTURE AND ORIGIN OF NEW VARIATION WITH NOTES ON ITS SIGNIFICANCE

The most characteristic feature of the new mutation which I am calling *Oe. Lamarckiana* mut. *funifolia*, is the strong revoluteness or downward curl of the leaf margins, which in the best developed examples causes the leaf to have almost a cylindrical form. The leaf tissue between the lateral veins becomes more strongly contracted than the veins thus giving the leaves an appearance superficially resembling that of a braided rope, as shown in Figs. 8 and 9. Cross-sections of the leaves of *Oe. Lamarckiana* and of *Oe. Lamarckiana* mut. *funifolia* are shown in Fig. 10. Associated with this revoluteness of the leaf margins is an irregular fine rugosity of the ventral (convex) surface of the leaves which gives the plants a markedly grayish aspect (Fig. 11). In most strongly revolute specimens numerous small protuberances often occur on the ventral surface of the leaves, on either side of the midrib (Fig. 12). A section of one of these protuberances is shown in Fig. 13, where it is seen to differ in structure in no essential way from the body of the leaf from which it arises. There is also some modification of leaf outline, the leaves being usually rela-

THE FUNIFOLIA MUTANT OF OENOTHERA LAMARCKIANA

The most striking characteristic of this mutation is the curled leaf margin, which gives the appearance of braided rope, whence the name *funifolia*. It differs also from its parent, *Oe. Lamarckiana*, in having no basal branches. This is one of three new mutants which are likely to be of much use in breeding experiments, and which are described at length in the text. Photograph by James P. Kelly. (Fig. 8.)

tively narrower and, particularly in the stem-leaves, usually narrowing rather abruptly to short-acuminate apexes which are sometimes almost spinescent. Occasionally the midribs of some of the stem-leaves end in a short sub-apical spine-like spur on the under (dorsal) side of the leaf, a characteristic which is much more strikingly and consistently associated with revolute leaves in *Oenothera pratincola* mut. *formosa* Bartlett. When typically developed the *funifolia* plants can be detected readily in very early rosette stages (Fig. 14 left) but in less fully developed plants of this type the revolute character does not appear conspicuously in the earlier leaves of the rosette, and the revolute

FUNIFOLIA COMPARED WITH ITS PARENT

On the left are two leaves (one showing the ventral surface, the other showing the dorsal) of the *funifolia* mutant; on the right are two of the parent, *Oe. Lamarckiana*, arranged in the same manner. Here is brought out in striking manner the difference in leaf-form which has entitled the mutant to the name *funifolia*. In addition to their narrower shape, the leaves of *funifolia* are grayish on the ventral surface, a characteristic which is not found in the parent. Photograph by James P. Kelly. (Fig. 9.)

margins are limited to the basal portion of the leaf-blade. This under-development of the *funifolia* characters has been particularly noticeable in the case of *funifolia* segregates from crosses with *Oe. franciscana*. This result in the case of the *franciscana* cross is doubtless related to the fact that the latter species has thicker, stiffer leaves than *Oe. Lamarckiana*, and that the stiffness of the leaves is to a certain degree antagonistic to the revoluteness produced by the *funifolia* factor. In all cases, however, the *funifolia* character has been sufficiently well developed, that an error of classification has occurred only in one or two cases.

In the adult stage the chief difference between mut. *funifolia* and its parent, *Oe. Lamarckiana*, aside from the revolute leaves of the former, consists in the lack of basal branches in *funifolia*, such as are invariably present in *Lamarckiana*. The characteristic habits of these two forms are well shown in Figures 14 (right) and 15.

SUDDEN APPEARANCE OF SEVERAL MUTANTS OR "MASS MUTATION"

The first *funifolia* plants appeared in 1918 in pedigree family number 1720, the offspring of a self-fertilized *Lamarckiana* of the cross-bred strain mentioned above. There were five individuals of the *funifolia* type in a family consisting of 100 individuals, 90 of which were typical *Oe. Lamarckiana*. When these five plants were first observed in pot culture in the greenhouse they had the appearance shown in

LEAVES OF FUNIFOLIA AND ITS PARENT, IN CROSS SECTION

The lower diagram represents a leaf of the *funifolia* in cross section, the upper one, a leaf of *Oe. Lamarckiana*. (Fig. 10.)

Fig. 16. At this stage the characteristic constrictions between the lateral veins are not present. The revolute leaves and grayish aspect suggested at first that these five plants were diseased, but it was demonstrated later that they were permanent normal hereditary characteristics.

This sudden quintuple appearance of a striking new type which had never before appeared in the extensive cultures of *Oe. Lamarckiana*, illustrates the phenomenon which Bartlett has called "mass-mutation," and the breeding tests which have indicated the method of origin of *funifolia*, may be used as a basis of interpretation of other cases of so-called "mass-mutation." The crosses of these five *funifolia* plants with their *Lamarckiana* sibs, and with *Lamarckiana* plants in other families, showed that the parent of family 1720 had been heterozygous for *funifolia*, but that the *funifolia* factor did not occur in any of my other *Lamarckiana* families, either in the independent strains or in the families most closely related genetically to family No. 1720. The conclusion seems justified therefore that the *funifolia* factor arose as a gene-mutation in 1916 in the production of the egg or the sperm whose mating resulted in the parent of family No. 1720.

Since *Oenothera Lamarckiana* is maintained in a heterozygous state by the presence of the two lethals, l_1 and l_2, in chromosome I, *funifolia* could become visible only through the process of crossing over. The relatively frequent crossing over of the *funifolia* factor from chromosome I*a* into chromosome I*b* or *vice versa* shows that there is an appreciable distance (possibly about 20 units) between the locus of the *funifolia* factor and the loci of the characteristic *Lamarckiana* lethals, l_1 and l_2. The only difference between "mass-mutations" and single (crossover) mutations is attributable to the fact that the loci of the former are relatively distant from the limiting lethals while the loci of the latter are very near to the lethals.

OTHER PARALLEL MUTATIONS

Perhaps the most interesting fact regarding mut. *funifolia*, is its status as a probable parallel mutation, since its characteristics are in essential agreement with those of Bartlett's *Oe. pratincola* mut. *formosa*. *Oenothera pratincola* and *Oe. Lamarckiana* are so unlike in every way that one can not logically assume a common ancestor except in a relatively remote past. If it should turn out, as I anticipate, that the *funifolia* factor in *Lamarckiana*

ENLARGED SECTIONAL VIEW OF FUNIFOLIA LEAF

One of the characteristic features of the *funifolia* mutant is the rugosity of the ventral (convex) surface. This is clearly brought out in the above drawing, which was made by J. Marion Shull from a mounted specimen. (Fig. 11.)

and the *formosa* factor in *pratincola* occupy identical loci, it will lend the strongest possible support to the view to which I have been led by other considerations, that there is a widespread homology of genotypic constitution in the Oenotheras. The necessary crosses have been made to test this question.

Oenothera Lamarckiana mut. *pervirens* mut. nov.

AN ALL-GREEN, RECESSIVE MUTANT FACILITATING ANALYSIS OF PIGMENTATION FACTORS

Oenothera Lamarckiana, as is well known, is characterised by pink-coned buds and greenish stems bearing numerous papillate hairs, of which the papillae are strongly reddened with anthocyanin pigment. There are, in addition, numerous characteristic details of form and size of all its parts. Breeding experiments have shown that *Oe. Lamarckiana* is a permanent heterozygote in regard to certain factors carried in one of its chromosome pairs (chromosome I), and that in one member of this pair (I*a* or "velans[1]") there is a factor for red bud-cones which is only partially dominant to the recessive factor for green or greenish bud-cones which occupies the corresponding locus in the other member, I*b* ("gaudens"[1]). It is probably the lack of complete dominance of the red-cone factor R^c, which gives *Oe. Lamarckiana* its characteristic pink cones. The presence of the recessive green-cone factor r^c is easily demonstrated by crosses between *Oe. Lamarckiana* and species characterized by green bud-cones, as this represents the back-cross of a heterozygote to the corresponding recessive and results in a 1 : 1 ratio, except as the ratio may be modified by linkage with lethal factors or by selective elimination. The presence of this receisves green-cone factor (r^c) is also evidenced by the frequency with which mutant derivatives of *Lamarckiana* have green or greenish buds. In most cases these green-budded mutants differ from *Lamarcki-*

[1] Names by which O. Renner has distinguished the two hereditary constitutions possessed by different germ-cells in *Oe. Lamarckiana*. They may be retained as names of the two members of chromosome pair No. I in this species.

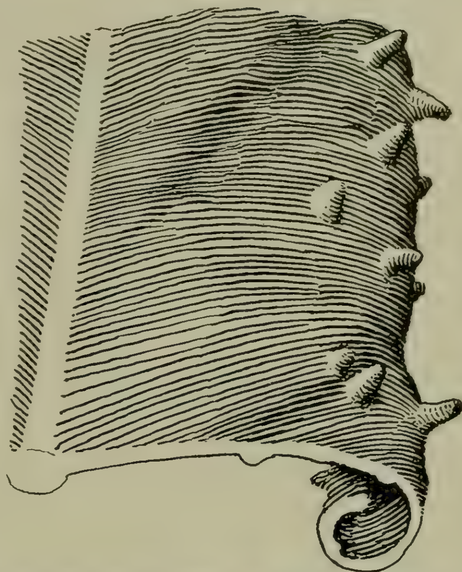
ana in many details of form, but in 1920 in family No. 193 there occurred among 78 typical *Lamarckiana* plants and 1 *bipartita*, one plant which was indistinguishable from *Lamarckiana* in nearly all details of form and size, but which had the buds entirely free from any trace of red pigment. The color of the papillae on the stems was not observed, but as all of the offspring of this plant by self-fertilization, have been wholly free from red papillae it may be assumed with assurance that this original specimen of mut. *pervirens* was characterized not only by wholly green buds, but also by wholly green stems.

SIMILARITY TO LAMARCKIANA SHOWN BY PARALLEL MUTATIONS

That mut. *pervirens* has essentially the same genotypic constitution as *Lamarckiana*, except in this complete loss of red pigmentation, is indicated by the composition of its progeny (No. 2046) for not only were there 140 *pervirens*, practically indistinguishable in form and habit from *Lamarckiana*, but there were in addition to these, two mut. *lata*, one mut. *oblonga* and one mut. *bipartita*, which differed from the parallel forms found in *Oe. Lamarckiana* only in being wholly free from red-pigmentation on buds and stems. There were also five unidentified mutants, one of which closely resembled *scintillans*, another *nanella* and a third *bipartita*.

ABSENCE OF PIGMENT AN AID TO GENETIC ANALYSIS

Since 1913 I have been tracing the genetical behavior of a factor R^s for intense reddening of the stems, but have had difficulty in many combinations because forms which do not possess this factor frequently show considerable reddening of the stems. In these the redness of the stems advances with advancing age, and is especially intensified with the onset of autumn coloration, so that classification into red-stemmed and green-stemmed series has become increasingly difficult in some crosses, with the advance of the season. The great advantage to be derived from the discovery of a form wholly free from red pigmentation, and having at the same time the splendid qualities of vegetative vigor and fecundity which have made *Oenothera Lamarckiana* such a satisfactory subject for genetical studies, will be sufficiently obvious, and it may be confidently expected that with the aid of a recessive type which is free from red coloration on both buds and stems, and whose stems show no trace of autumn reddening the pigmentation factors will be capable of a much sharper analysis than has been possible heretofore.



WARTLIKE OUTGROWTHS, A CHARACTERISTIC OF THE FUNIFOLIA MUTANT

The above sketch, drawn by J. Marion Shull, shows a portion of a leaf of the funifolia mutant bearing the peculiar wartlike outgrowths which frequently occur on highly developed specimens of this type. (Fig. 12.)

Oenothera Lamarckiana mut. *vetaurea* mut. nov.

THE FIRST BREAK IN FLOWER COLOR IN VARIANTS OF LAMARCKIANA

Few characters are more constant throughout a large genus than is the yellow flower color of the Oenotheras.

ENLARGED SECTION ON A FUNIFOLIA OUTGROWTH

In this drawing, made by J. Marion Shull, is shown in detail the structure of one of the peculiar outgrowths which characterize the *funifolia* mutant. (Fig. 13.)

For hundreds of years, however, a *sulfurea* or pale yellowish-white form of *Oe. biennis* L. has been known, widely distributed in Europe, and more recently the same variation has been observed in *Oe. suaveolens*, also, in nature. *Sulfurea*-flowered mutants have also arisen in experimental cultures of Stomps[2] and de Vries,[3] and the *sulfurea* factor has also been introduced into other species by means of hybridization, and has yielded

[2] Stomps, Theo. J. Parallele Mutationen bei *Oenothera biennis* L. Ber. Deutsch. Bot. Gesell. **32**: 179-188. 1914.

[3] de Vries, Hugo. Mutations of *Oenothera suaveolens* Desf. Genetics **3**: 1-26. 4 fig. Jan., 1918.

CHARACTERISTICS OF THE FUNIFOLIA MUTANT

The illustration on the left shows (above) a young rosette of *Oe. Lamarckiana*, and (below) one of the *funifolia* mutant. When typically developed, the mutant can be detected even in very early rosette stages.

On the right is shown an adult plant of the *funifolia* mutant. By comparison with Fig. 15, it will be seen that the mutant is distinguished from its parent by the complete lack of basal branches. (Fig. 14.)

genetic results of the utmost value in working out the genotypic constitution of the Oenotheras. So far as I know no other "break" has occurred in the flower-color of Oenothera until mut. *vetaurea* appeared in my cultures during the past summer (1921). This mutation consists in a departure from the common citron yellow color typical of all wild species of this genus, to a color which ranges from Naples yellow (Ridgway) in the more distal portions of the petals, to slightly deeper shades in the same series of colors, in the center of the flower. The filaments and the distal portion of the stigmas are approximately primulinus yellow. The warmer tone in the center gives the flowers an aspect almost as if they were aglow with a light of their own.

OENOTHERA LAMARCKIANA

Since the work of Professor Hugo De Vries with mutants of *Oe. Lamarckiana*, this plant has been extensively used by students of genetics. In the accompanying paper, Professor Shull describes three new mutants which have originated at Princeton, and which are likely to prove very useful. (Fig. 15.)

This beautiful mutation has appeared in two pedigree families (Nos. 2047 and 2052) which were progenies of two sibs in family No. 198 of my cross-bred strain of *Oe. Lamarckiana*, in 1920, and this fact makes it certain that the gene-mutation which made the realization of the *vetaurea* color possible occurred at least as early as 1919. Steps have been taken to test the extent to which the recessive *vetaurea* factor, *v*, is distributed in the cross-bred strain of *Oe. Lamarckiana* and the results of these tests should indicate whether the *vetaurea* gene-mutation probably occurred previously to 1919 or not.

Family 2052, in which *vetaurea* was first discovered, was the progeny of a typical specimen of *Oe. Lamarckiana*, and the single *vetaurea* specimen in this family was in all respects, except the color of the flowers, a typical pink-coned *Lamarckiana*. The other members of this family were all *rubricalyx*, being the F_1 of a cross between *Lamarckiana* and the characteristic homozygous alethal segregate from *Oenothera rubricalyx*, which I call *Oe. latifrons*. Only an accident of technique which resulted in a self-fertilization of the mother plant made it possible for the *vetaurea* specimen to appear in this family.

The parent of 2047, the other family in which mut. *vetaurea* has appeared, was itself a mutation in the cross-bred *Lamarckiana* family 198. It differed from *Lamarckiana* in having the bud-cones nearly free from red pigment, and the stems a clearer green, but finely speckled with red papillae as in *Lamarckiana*. The capsules were a little less well developed and slightly more divergent than in *Lamarckiana*. One of the two zygote lethals characteristic of *Lamarckiana* was also wanting in this green-budded mutant as shown by the fact that family 2047, produced by self-fertilization, split into (a) the parent type, namely, green-budded near-*Lamarckiana*, and (b) near-*decipiens*,

POT-GROWN ROSETTE OF FUNIFOLIA

The conspicuously revolute development of the basal portions of the leaves is characteristic of this mutant. Photograph by James P. Kelly. (Fig. 16.)

in the ratio 62 : 32,—almost exactly the 2 : 1 ratio expected in such a case.

Vetaurea AND *sulfurea* POSSIBLY ALLELOMORPHIC

There were some losses of plants in this family by death, and a small number, especially of the slow-growing *decipiens* type, failed to bloom. Of those which bloomed there were in the (a) group 40 yellow : 13 *vetaurea*, and in the (b) group two yellow: seven *vetaurea*. While these numbers are too small to allow one to place any dependence on their validity as a measure of the relative positions of the factors involved, it will be noticed that they assume the form of a linkage ratio, which gives a preliminary hint that the *vetaurea* factor is in chromosome I where the characteristic zygote lethals occur, and the amount of crossing over between the lethals and the *vetaurea* factor seems to be about the same as that between the *sulfurea* factor and the lethals. It will not be surprizing therefore if the *vetaurea* factor should be found to be allelomorphic to the *sulfurea* factor. The necessary steps have been taken to test this and many other problems which the presentation of this new unit-factor has suggested. An alternative hypothesis regarding the relation of *vetaurea* color to yellow and sulfur is also being tested.

KITH AND KIN

Alexander Graham Bell
Washington, D. C.

IN DEALING with genealogical subjects I am much surprised at the poverty of the English language in words expressive of relationship.

We have no term to express generally the relation of one member of a family to another irrespective of sex. We speak of "brothers and sisters" but have no common term for the relationship intended, unless the rather clumsy word "siblings" recently proposed should become generally adopted.

We have no general term, irrespective of sex, for the relationship indicated by the words "uncle and aunt," nor have we any other word than "cousin" to express collateral relationship, and we use the term in the most vague way.

It is surely advisable, in dealing with genealogical subjects, to adopt a terminology that shall be clear, distinct and unambiguous.

I have hitherto employed a plan of designating the ancestors of an individual by numbers (2, 3, 4, 5, 6, etc.), even numbers representing males and odd numbers females (see Journal of Heredity for May 1921). While this method meets the wants of a scientific classification of ancestry, it does not fulfil the need for an ordinary terminology.

We often allude to our "kith and kin." We all have a pretty definite idea of what we mean by "kin,"—relationship through a common ancestor, our own kindred, our blood relatives; but what do we mean by "kith?" The word by itself is obsolete. Webster defines it as "acquaintance, intimate acquaintance and relationship."

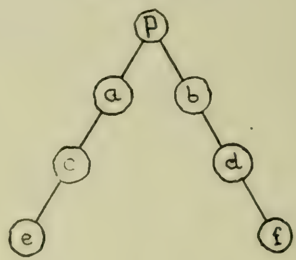
I think it would be a good plan to revive the term "kith" and give it the special meaning of relationship through a common descendant.

Kin:—Persons who have a common ancestor are kin.

Kith:—Persons who have a common descendant would be kith.

The following diagrams illustrate the proposed terminology.

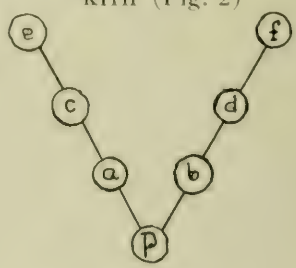
KIN (Fig. 1)



Kin:—All the descendants of the propositus *P* in the above diagram are kin to one another. *a* and *b* are first kin, *c* and *d* are second kin, *e* and *f* are third kin, and so on.

Under this terminology the members of a family (brothers and sisters) are first kin to one another by virtue of the possession of a common parent (either father or mother). Where the brothers or sisters, (*a b*) have the same father and mother they are doubly first kin to one another: or, perhaps, it would be better to say they are full kin, because all of their ancestors are the same in each case.

KITH (Fig. 2)



Kith:—All the ancestors of the propositus *P* in this second diagram are kith to one another. *a* and *b* are

first kith, c and d second kith, e and f third kith, etc.

Under this terminology husband and wife become first kith when they have a child, P. All of the four grandparents of the child P would be second kith, the eight great-grandparents would be third kith, the sixteen great-grandparents fourth kith, etc.

The word "kith" would thus mean more than mere "acquaintance." It would indicate a sort of indirect blood relationship. In the case of persons who are kith their blood mingles in their common descendant.

These definitions of kith and kin seem to me to be satisfactory as far as they are used to express the relationship of persons belonging to the same generation. The case changes, however, when you are dealing with persons in different generations, as "uncle and nephew," "first cousin once removed" etc. In such cases it may be necessary to specify the individual degree of relationship to the common ancestor or descendant. For example, uncle and nephew, a and d Fig. 1, are first and second kin through the common ancestor P, and first cousins once removed, c and f are second and third kin through the common ancestor P.

In the case of persons who are kith it would be the same thing reversed, the blood relationship would be through a common descendant. In Fig. 2, a and f would be first and third kith through the common descendant P, a relationship for which there is at present no name whatever.

Our terms for ancestors and descendants are also very clumsy and become impracticable of use when we get a few generations from the individual studied. The relation of ancestors is more quickly apparent if we speak of first parents, second parents, third parents, fourth parents, etc., than if we say parents, grandparents, great-grandparents, great-great-grandparents. The advantage is more and more obvious the farther we go from the *propositus*, P; for it is certainly simpler to speak of his sixth parents than of his great-great-great-great-grandparents.

The same terms could be used for descendants and instead of speaking of children, grandchildren and great-grandchildren we could say first children, second children and third children.

In a subject of such general interest as this it seems to me important that the terminology should be easily understood, and I hope that these suggestions will be of use in starting a discussion of the whole subject.

Foundations of Human Genetics

GRUNDRISS DER MENSCHLICHEN ERBLICHKEITSLEHRE UND RASSEN*-HYGIENE, Band I, Menschliche Erblichkeitslehre, von Prof. Dr. Erwin Baur, Prof. Dr. Eugen Fischer, u. Dr. Fritz Lenz. Mit 65 fig. im Text. J. F. Lehmanns Verlag, Muenchen, 1921, pp. 305.

Three scholars of recognized standing have united to put out this comprehensive work on eugenics and social hygiene. In the present volume Dr. Baur outlines the general principles of heredity and variation in the first part, while Dr. Fischer in the second part discusses racial differences in mankind. The third and fourth parts, by Dr. Lenz, are respectively devoted to the inheritance of tendencies to disease, and to the inheritance of mental traits. It is stated that the concluding volume, not yet published, will be entirely the work of Dr. Lenz, and will be devoted to "race hygiene." The present volume, which is compiled principally from continental sources, gives a good general picture of the subject. Dr. Fischer and Dr. Lenz confine themselves mainly to stating that certain traits are inherited, without discussing in detail the manner of inheritance.—P. P.

INHERITANCE OF A PIT IN THE SKIN OF THE LEFT EAR

James Ernest Kindred
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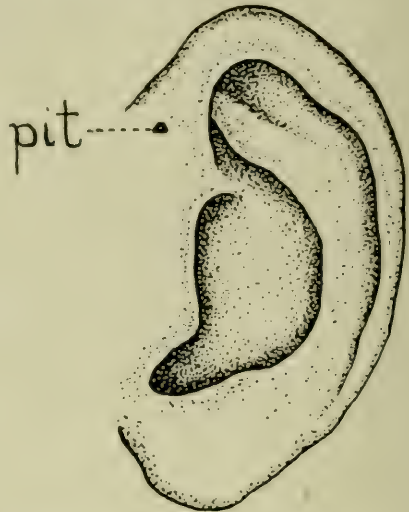
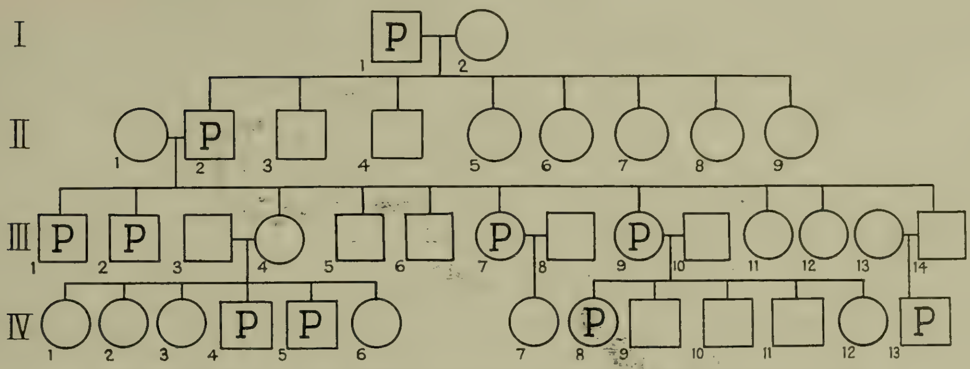
IN DISCUSSING the characteristics of the ears of a group of people in connection with Schofield's paper (1917) on the inheritance of the bi-lobed ear, one of the members of the group called attention to the fact that she had a bi-lobed ear, but did not know of such a condition in any of her relatives. Her mother then remarked that she had a peculiar pit on the side of her left ear. Upon examination of this ear, a small pit was observed in the skin of the proximal end of the upper part of the helix. The accompanying sketch shows its relative position. My informant then told me that this pitting was a distinctive mark in her family and by carefully questioning her, I learned the following interesting facts concerning the inheritance of this peculiar marking. A graphic summary of the inheritance of this pit is given in the chart on the opposite page.



Position of the inherited pit. (Fig. 17.)

As far as the propistus could recollect, the marking was first noted in her paternal grandfather (I, 1). Her father (II, 2), one of eight children, had the pitted condition, and although she did not know whether or not his sisters or brothers were so marked, it seems more than likely that they were, because some of her cousins had a pitted helix. In the third generation there were four individuals, 2 girls and 2 boys, with the pitted helix. The propistus (III, 7), is one of the girls, her daughter (IV, 7) does not have the pitted helix. The sister of the propistus (III, 9), also having the pitted helix, is married and has five children, one daughter (IV, 8) having the pitted helix. None of the boys with pitted helix in generation III, married. Another sister of the propistus (III, 4), not pitted herself, is married and has six children, two boys and four girls. Both of the boys (IV, 4, 5) have the pitted helix. A brother of the propistus (III, 14) does not have the pitted helix, but his only son has. The propistus states that in all cases the marking is on the same spot of the same ear (left).

Thus in this fraternity there is some factor inherited which has to do with the formation of the skin in the region of the proximal end of the helix. The pitting occurs in some individuals of each generation from the time of its appearance and may be transmitted by individuals not marked themselves. Further, it may be transmitted by either sex. In some cases the offspring of unpitted parents are pitted, while in other cases the pit does not occur in the offspring of a mating in which one or the other of the parents is pitted. Judging from the manner of its appearance, the marking is neither dominant nor recessive, but must fall into the intermediate doubtful class of incomplete dominance.



INHERITANCE OF PIT IN THE EAR THROUGH FOUR GENERATIONS

The propositus in this case is No. 7 in the third generation. Her grandfather (I, 1) was the first known to have the pitted condition. He transmitted it to his son (II, 2), father of the propositus. He (II, 2) passed it on to four of his children as shown in the third generation. Two others of the third generation, not possessing the pit themselves, transmitted it to individuals in the fourth generation. It may also be seen that III, 7 did not transmit the condition to the next generation, but that III, 9 did. (Fig. 18.)

A New Study of Eugenics

The Trend of the Race: a study of present tendencies in the biological development of civilized mankind, by Samuel J. Holmes, Ph.D., professor of zoology in the University of California. Pp. 396, price $4 net. New York, Harcourt, Brace & Co., 1921.

Never before have the data of eugenics been subjected to such a thorough criticism as by Dr. Holmes. Entirely in sympathy with the principles underlying the eugenics movement, he has made a valuable contribution to it by his exhaustive treatment of the literature, particularly that from Europe. His conclusions generally accord with those accepted by other eugenists. The book is lacking in careful definitions of the terms used, and makes little attempt to suggest remedies for the various dysgenic trends noted. After a few introductory chapters on inheritance, and on the birth rate, it is devoted almost wholly to a consideration of the various selective influences at work on mankind. It is announced that a full bibliography of the subject is to be published separately.—P. P.

For and Against Birth Control

The Control of Parenthood, edited by James Marchant, introduction by the Bishop of Birmingham. Pp. 222. New York and London, G. P. Putnam's Sons, 1920.

Every intelligent person favors birth control—in one sense or another; but most intelligent persons reprobate the birth-control propaganda which has been a glaringly unscientific treatment of a biological subject. In this volume the problem is discussed by J. Arthur Thomson, Leonard Hill, Dean Inge, Harold Cox, Mary Scharlieb, F. B. Meyer, A. E. Garvie, H. Rider Haggard and Marie C. Stopes, some being pro, some being contra, and one or two apparently "on the fence." The volume probably presents the sanest and most thoughtful discussion of the subject that is available, although the rhapsodical views of Dr. Stopes on "maternal impressions" hardly belong in a serious book. While nothing new is presented, the facts and arguments on both sides are brought forward in a way that should stimulate any responsible person to do a good deal of thinking, if his mind is not already closed on this topic.—P. P.

ONE OF THE FOREMOST SIRES OF THE HOLSTEIN-FRIESIAN BREED, SIR PIETERTJE ORMSBY MERCEDES (44931)

This sire has fourteen daughters with records of over 1000 pounds of butter (80% fat). Sixty-one of his daughters in the Advanced Register have records that average 17,816.29 pounds of milk, 3.6%, containing 641.38 pounds of fat. Sir Pietertje Ormsby Mercedes may be termed an out-cross sire, his parents being unrelated. "The genealogy table shows very clearly that this animal was not developed on the hit and miss plan, but that his ability to transmit high production is caused by the bringing together of blood lines that are noted for their production and their ability to transmit this production." (Fig. 19.)

SELECTING HOLSTEIN-FRIESIAN SIRES FOR HIGH YEARLY PRODUCTION

A Detailed Study of the Records of 1478 Registered Animals Proving the Value of Certain Blood Lines in Transmitting High Production

R. E. Hunt

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SUCCESS in the dairy business depends very largely upon average production of the cows that are in the milking herd. The average of all dairy cows in the United States is very much below what it should be. The function of the improved dairy breeds is to increase this low average to a very much higher average.

The breeder of purebred dairy stock seeks to raise the best producers possible in order that his milking herd may reach a very high level of production. Males from the purebred herd may be sold to dairymen with grade or purebred milking herds with the result that the production of their heifers from this registered sire will be quite superior to their dams. In order to assure success in breeding the above mentioned stock, it is necessary to have some definite method of making the proper selection of the females, and especially the herd sire. This means that we must have some method of locating the leading blood-lines of the breed and the possibilities of the sire selected proving his prepotency for average high production.

Of course, most dairymen and purebred breeders will select young untried sires. This means that their sire's future will be judged entirely by the records of his ancestors. The Blue Books of the Holstein-Friesian Association of America give a great mass of very valuable material, but it does not show the lines of greatest production or the way this lineage transmits high production. This paper is an attempt to show the lineage of highest production and how it is transmitted down through the various generations.

METHODS OF ESTIMATING RECORDS

The data reported in this paper was taken from volumes 24 to 30 inclusive of the official Blue Book and Herd Books of the Holstein-Friesian Association of America. The pedigrees of all cows having yearly records equivalent to or greater than 600 pounds of butterfat were tabulated for three generations, and all cows having yearly records equivalent to or greater than 800 pounds of butterfat were tabulated for five generations.

Yearly records were chosen for the basis of this study because the dairyman milks his cows twelve months in the year and wants to know what he can expect from the daughters of the herd sire of his selection.

The records of all cows used were made comparable by estimating the amount of butterfat produced by all cows under five years on the basis of the yearly requirements. For the lack of better and more authentic information, it was assumed that the requirement of 250.5 pounds of butterfat for a heifer freshening at the age of two years or less, increased by (.1) one-tenth of a pound of fat for each day over two years until the age of five years is reached, when the cow is considered mature and the required production is 360 pounds of fat. The record of a heifer freshening at the age of two years and no days and producing 500 pounds of fat would be considered equivalent to a 718.4 pound mature record. The number of pounds of fat produced times 360, the requirement for a mature cow, divided by the

KING OF THE PONTIACS, ANOTHER HOLSTEIN-FRIESIAN LEADER

A few years ago, this sire was considered one of the leading representatives of his breed. His sire, Pontiac Korndyke, is one of the greatest of the Holstein-Friesians. Aside from having a large number of daughters that have made large seven day and yearly records, King of the Pontiacs has also some great breeding sons, such as King Pontiac Champion and Spring Farm King Pontiac. King of the Pontiacs resulted from the mating of unrelated parents. A study of the pedigrees of this and the other sires listed in this paper shows that "they are the result of a wise selection of sires in the improvement of the individual or the herd." (Fig. 20.)

requirement of the heifer at the age of freshening, or in this case,

$$\frac{500 \text{ lbs. fat} \times 360 \text{ requirement for mature cow}}{250.5 \text{ requirement for heifer at 2 years}} = 718.4 \text{ lbs. fat}$$

or the amount of butterfat this heifer would produce if she were mature, handled under similar conditions and had not been injured before she reached maturity. This method of estimating records may not be absolutely correct, but that point will not be debated. This much can be said in its defense: It is based on the requirements of the American Jersey Cattle Club, the Guernsey Breeders' Association, the Ayrshire Breeders' Association, and the Holstein-Friesian Association of America for admittance for yearly records.

TABLE I: *Advanced Registry Requirements for 600 lbs. Standard*

Class	Reg. Req.	600 lbs. Standard
Mature	360.00	600.00
Senior 4-year-old	341.75–360.00	569.58–600.00
Junior 4-year-old	323.50–341.75	539.17–569.58
Senior 3-year-old	305.25–323.50	508.75–539.17
Junior 3-year-old	285.00–305.25	475.00–508.75
Senior 2-year-old	268.75–285.00	447.91–475.00
Junior 2-year-old	250.50–268.75	417.57–447.91

The standards of 600, 800 and 1000 pounds of butterfat were selected because any cow producing over 600 pounds or its equivalent is a high producing cow and her producing qualities have been highly developed. The sire of five or more 600 pound daughters shows exceptional prepotency for producing high producing daughters. The 800 pound or its equivalent group was made to show exceptionally high production. Any cow in this list is a great cow, and any sire with two or more 800 pound daughters must transmit exceptional producing qualities. The 1000 pound or its equivalent group are composed of the breed's greatest producing cows. Any sire with a 1000 pound daughter should be considered among the breed's best sires. The divisions were made to determine the sires that produced the greatest producing daughters and the blood lines of these great sires.

From Table II it will be noted that the number of animals in each

TABLE II: *1201 Cows Classified as to Equivalent Production, With Number in Each Group and Average Per Cent of Fat*
(Data do not include records found in Volume 30)

Fat Production	Over 1100 lbs.	1000 to 1100 lbs.	900 to 1000 lbs.	800 to 900 lbs.	700 to 800 lbs.	600 to 700 lbs.
Number of cows	6	31	80	167	280	637
Average % fat	4.32	3.88	3.63	3.54	3.63	3.44
Maximum % fat	4.53	4.64	4.59	4.47	4.48	4.40
Minimum % fat	3.68	3.18	2.92	2.81	2.56	2.57

group, except the one over 1100 pounds fat or its equivalent, has sufficient numbers to give definite results. Beginning with the average per cent fat for the cows with a production of from 600 to 700 pounds fat, or its equivalent, 3.44 per cent, it gradually increases, except the cows in the 700-800 pound fat class, and the same as that for the cows in the 800-900 pound fat class, and the same as that for the cows in the 900-1000 pound class. The maximum test, 4.64 per cent fat, was for a cow producing over 1000 pounds fat or its equivalent. The minimum test of 2.56 per cent fat was the lowest of any really high producing cow and it may be safely said that it is practically impossible for a cow to make over 1000 pounds fat or its equivalent unless the average test is at least 3 per cent fat.

Table III gives a list of sires having one or more equivalent to 1000 pound butterfat daughters, there being 52 daughters that will qualify for this list. King Segis Pontiac Count with 29 Advanced Registry daughters, is the sire of five daughters with a yearly production of 1000 pounds butterfat or its equivalent, a most wonderful showing for his ability to transmit extremely high production. King Hengerveld Aaggie Fayne, with 34 Advanced Registry daughters, has three 1000 pound daughters. Six other sires have two daughters each, and the remaining thirty two 100 pound daughters each have a different sire, bringing out the fact that no one particular sire has produced all the extremely high record cows, and that of the total 52 more than half of them are sired by animals with only one extremely high record daughter.

While the blood lines of these animals are very closely related, by studying the

HOLSTEIN-FRIESIAN COWS ON A VIRGINIA FARM

"Success in the dairy business depends very largely upon the average production of the cows that are in the milking herd." This paper shows, by presenting the lineage of certain well established families, how "well bred animals of good inviduality are essential to successful breeding" for high milk and butterfat production. Yearly records form the basis of the study, and it is noted how certain blood lines are responsible for the greatest records of production. Photo by L. W. Beeson. (Fig. 21.)

genealogy table which follows it will give you the relationship of these sires, showing that they virtually all fall into three well defined families, with various sub-branches.

In studying the pedigree of King Segis Pontiac Count, it will be noted that he combines the blood lines of King Segis Pontiac Korndyke, and Hengerveld DeKol, and that these three individuals represent three of the greatest sires that brought about early improvement in the Holstein-Friesian breed in America. Practically all the sires found in this pedigree are noted for the production of their daughters and their ability to tramsmit production down through the various generations.

Table IV gives the sires having two or more daughters with records equivalent to or greater than 800 pounds Three hundred and seventy-two cows have a production equivalent to or greater than 800 pounds, but in the list of sires with two or more daughters there are only 58. Sir Pietertje Ormsby Mercedes heads this list with 16 daughters, King of the Pontiacs is second with 14, King Segis Pontiac Count is third with 12. Pontiac Aaggie Korndyke has 9, King Pontiac Champion 8, and Sir Johanna Piebe has 7. Two sires have 6 daughters each, two have five, four have 4 daughters each, 14 sires have 3 daughters each, 30 sires have 2 daughters each, and the remaining 166 cows with high production are sired by different individuals.

This again brings out the fact that no one particular sire has a monopoly on all the really high producing daughters, and that 166 sires have been able to produce one such daughter, but no more. When we consider that only 58 sires have qualified for this list, it gives us some idea of the value to be placed upon the animals found in this list, and the wonderful records of their daughters, as well as their ability to transmit high production. This is more forcibly brought out when one studies the genealogy table, tracing out the blood lines and relationship of these sires It is seen that these sires are found in the same blood lines as the list of sires with 1000 pound daughters, and in fact are so closely related that it would be impossible to draw a line or show any distinction between the blood lines of one group and the other.

Table V is made up of sires having five or more daughters with records equivalent to or greater than 600 pounds butterfat. Sir Pietertje Ormsby Mercedes heads this list with 42 daughters, King of the Pontiacs is second with 25, King Pontiac Champion is third with 22, Dutchland Colantha Sir Inka is fourth with 19, Sir Johanna Fayne with 17 is fifth. Another sire has 14 daughters, three sires have 13 each, one has 12, one 11, four have 10, six

LONE STAR PONTIAC SEGIS (239068)

A daughter of King Segis Pontiac Count, owned by the U. S. Bureau of Animal Industry. Her record at the age of four years and two months was 21,355.3 pounds of milk, containing 680.33 pounds of butterfat. A daughter of this cow, by the unrelated sire, Piebe Laura Ollie Homestead King, 110474, has a record at the age of two years and one month of 16670.7 pounds of milk, containing 498.33 pounds of fat. A daughter of this latter cow, grand-daughter of Lone Star Pontiac Segis, and sired by a son of King Segis Pontiac Count, has a record at the age of two years and two months of 14,319.6 pounds of milk containing 445.22 pounds of fat. Photo from U. S. Dept. of Agri. (Fig. 22.)

have 9, five have 8, five have 7, four with six daughters, seventeen with 5 daughters each, twenty-seven have 4 daughters each, forty nine have 3 daughters, one hundred and six have 2 daughters each, and 999 have one daughter each, with a p·oduction equivalent to or greater than 600 pounds butterfat.

This list of sires is very similar to those found in Tables III and IV. By referring to the genealogy table, you will note that they are very closely related, and that this fact is brought out very clearly that it is important, in selecting a herd sire, to select one from a lineage where there is uniformly high production. The mere fact that a sire has one high producing daughter does not mean that he is going to transmit high production to all his offspring. In this study, every sire listed undoubtedly has the ability to transmit high production to his offspring.

In studying the genealogy table, it brings out most forcibly that certain blood lines are capable of transmitting high production, and that certain other blood lines, not included in this genealogy table, are not capable of such production. It is unreasonable its believe that other families or blood lines have not been in the hands of good dairymen who understand feeding, and who gave their cattle good attention and the opportunity to make high records, but we do not find these in-

TWO WORLD'S CHAMPION MILK PRODUCERS

Both are daughters of the famous sire, King Segis Pontiac Count. The one at the top is Jewel Pontiac Segis (H.B. 229a61), three years old at the time of the photograph. Her record then for butter, one year, was 1,171.15 pounds, and milk, one year, 27,068.5 pounds. The lower photograph is of Beauty Beets Walker Segis (H.B. 290163), whose record of butter production for one year is 1,040.83, and milk 25,343.3 pounds. (Fig. 23.)

dividuals in the lists of actual high records of production.

If this paper brings out any one thing it is the fact that certain well established families can transmit high production and that certain other families cannot.

In studying the pedigree of Sir

Pietertje Ormsby Mercedes, and comparing it with the genealogy table, it shows very clearly that this animal was not developed on the hit and miss plan, but that his ability to transmit high production is caused by the bringing together of blood lines that are noted for their production and their ability to transmit this production. Practically every sire found in this pedigree can be located in the genealogy table, and it is the bringing together of such blood lines that makes a really desirable sire.

One of the most encouraging features of the study of the pedigrees of Sir Pietertje Ormsby Mercedes, King Segis Pontiac Count, and King of the Pontiacs—and in fact, almost any sire found in these lists,—is the fact that they are the result of a wise selection of sires in the improvement of the individual or the herd. By going back 4, 5, or 6 generations, the females have nothing particular to make them great individuals, but by the continual use of really high class sires, wonderful individuals have been developed, and it brings out the importance of a good sire used upon ordinary individuals and the possibility of increasing the production of the herd by the wise and proper selection of sires.

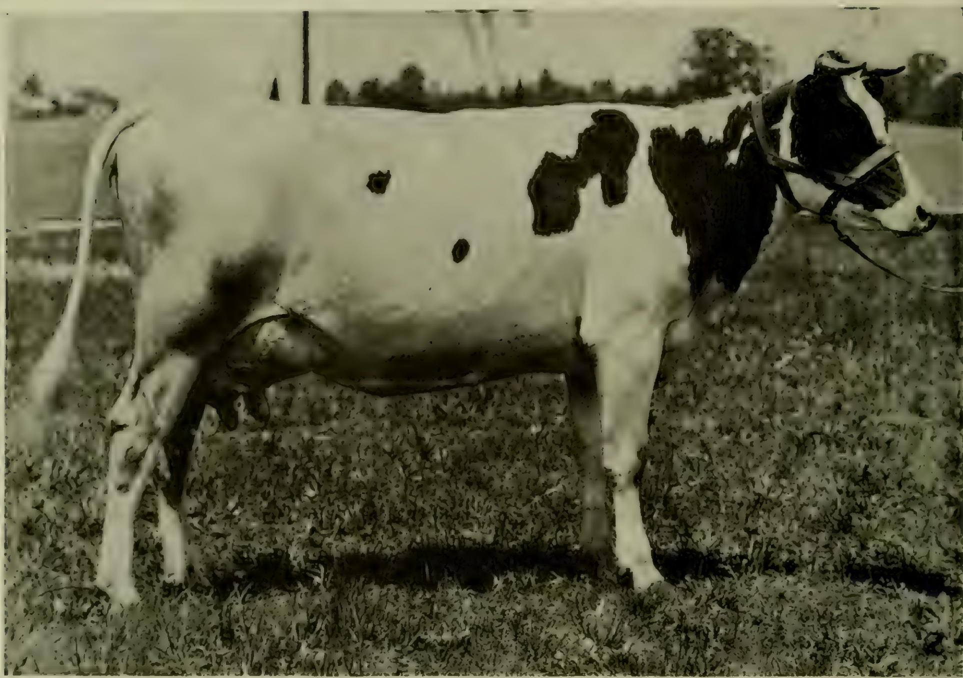
METHOD OF READING NUMBERS IN TABLE VI

The first figure in the parenthesis indicates the number of the sire's Advanced Registry daughters; the second figure, the number of sons that he has that are sires of tested daughters; the third figure; the number of daughters that are dams of tested daughters; the fourth figure, the number of his daughters that have produced the equivalent to or more than 1000 pounds of butterfat; the fifth figure, the number of his daughters that have produced the equivalent to or more than 800 pounds of butterfat; the sixth figure, the number of his daughters that have produced the equivalent to or more than 600 pounds butterfat. All daughters with a production equivalent to or greater than 1000 pounds butterfat are included in the number of equivalent to or greater than 800 pounds butterfat, because it is a production greater than 800 pounds butterfat. In the equivalent to or greater than 600 pounds butterfat class, the number includes all daughters with a production equivalent to or greater than 600 pounds.

METHOD OF READING TABLE VI

Table VI should read as follows: Sir Henry of Maplewood is the sire of two sons that are sufficiently important to be considered in this table, namely, Mechthilde Sir Henry of Maplewood and Sir Mechthilde of Maplewood, as indicated by the line dropping straight down and the names of the sons slightly indented. In the same way, Mechthilde Sir Henry of Maplewood is the sire to two sons, Tirania's Sir Mechthilde and Empress Josephine 3d Sir Mechthilde, who is the sire of Manor Josephine DeKol, who, in turn, is the sire of Pontiac Korndyke. Pontiac Korndyke has three sons in the preceding lists, namely, King of the Pontiacs, Pontiac Aaggie Korndyke, and Pontiac Hesseltje Korndyke. King of the Pontiacs has three sons listed, King Pontiac Champion, Spring Farm King Pontiac, and Cornucopia Pontiac Johanna Lad. In the second column it will be noted that King Segis has nine sons in the preceding lists, King Segis Pontiac, King Segis Hengerveld Vale, Sir Ormsby Burke Segis, Sir Walker Segis, Walker Korndyke Segis, and DeKol Beets Segis. King Segis is sired by Mercedes Julip's Pietertje Paul, who in turn is sired by Johanna Rue 2d's Paul DeKol, he by Paul Mutual DeKol, the son of Paul DeKol. Where a sire has only one son, that animal is placed immediately below his sire and slightly to the right. Where a line is dropped down it indicates that a sire has more than one son in the preceding lists. The number of sons listed are all numbered and are attached to the same perpendicular line.

Table VI gives the genealogy of ALL



A WORTHY DESCENDANT OF NOTABLE ANCESTORS

Johanna De Kol Concordia (310231) is owned by the U. S. Bureau of Animal Industry. Her record made at the age of three years and seven months is 19,036.7 pounds of milk, containing 671.2 pounds of fat. Her sire is a son of Sr. Fayne Concordia who traces in a direct male line to the great foundation sire, Paul De Kol, and out of Ona Clothilde De Kol 2nd, who has a record of 835 pounds of fat at the age of nine years and six months, and has a daughter with a record of 1013 pounds of fat. Ona Clothilde De Kol 2nd's mother is the great cow Ona Clothilde De Kol who has a record of 876 pounds of fat at eleven years and ten months of age, and heads a four generation group of female descendants in which each one has a record exceeding 800 pounds of butter fat. Photo from U. S. Dept. of Agri. (Fig. 24.)

the famous Holstein-Friesian sires when based on the performance of their offspring in making high yearly records. One of the striking features is the influence of the wonderful cow, DeKol II. This cow was bred to Sir Abbekerk and produced DeKol II Butter Boy, and it is from this lineage that we get such famous sires as Hengerveld DeKol, Sir Hergerveld Model Johanna, and Sir Hergerveld DeKol. When Neptune Jr. was bred to DeKol II, they produced DeKol II Prince, the sire of Paul DeKol, and it is from this lineage that we get such famous animals as Segis, King Segis Pontiac Count, Ignaro DeKol, King Mead of Riverside, Sir Johanna Piebe, Sir Veeman Hengerveld, and many other wonderful producing sires. Thus, when Paul DeKol was bred back to his grandam, DeKol II, this union produced DeKol II Paul DeKol, and from this lineage we have such animals as Sir Homestead Skylark and Canary Paul. When Netherland Alban was bred to DeKol II they produced DeKol II Netherland, and from this lineage we have Manor DeKol, and Korndyke Queen DeKol's Prince. When Manor DeKol was bred to his grandam, DeKol II, they produced DeKol 2d Butter Boy 3d. DeKol 2d Butter Boy 3d is the sire of such wonderful bulls as Friend Hengerveld DeKol Butter Boy, Hygeia Veeman Butter Boy, and from this lineage if high producing sires, coming directly from DeKol II, we have the wonderful sire, Sir Henry

A PRODUCT OF CAREFULLY SELECTED MATINGS

Lady Colantha Walker (365573) has a record of 17,843 pounds of milk, 546 pounds of fat, at the age of two years and two months. The top male line of her pedigree for five generations shows an unbroken line of great breeding sires, at the head of which is Sarcastic Lad, through whose sons have come some of the best producing strains of this breed. In addition to their ability to transmit high production, the value of the sires may be seen in the records of their daughters. (Photo from U. S. Dept. of Agri.) (Fig. 25.)

of Maplewood, which transmits down through one line, Pontiac Korndyke, the sire of King of the Pontiacs, while down through the second lineage, Jack Mercedes, the sire of Sir Pietertje Ormsby Mercedes. This family is very closely related to the DeKols. In fact, the different lines have been interbred a great deal, and it is hard to state which lineage has produced the most wonderful results.

Another line of breeding is the Sarcastic Lad, which is distantly related to Netherland Prince, the founder of the Manor DeKol line if breeding, including such wonderful sires as DeKol 2d Butter Boy 3d. From the Sarcastic Lad line of breeding comes such famous animals as Holmstead Girl DeKol Sarcastic Lad, Woodcrest Tehee Star Farm Johanna Lad, Sir Korndyke Cornucopia, and many others.

From the above lines of breeding you will find all the high producing sires of the breed, with the exception of a small family which we shall designate as Admiral Walker, the sire of Walker Pietertje and the grandsire of King Walker.

In selecting herd sires for purebred or grade herds of Holstein-Friesians, where you desire high yearly production, it seems necessary that the pedigree should contain as many animals as is possible that are found in the lineage as presented in Table VI. It certainly is very forcibly brought out that the high producing cows come from certain definite lines of breeding, and that certain other lines of breeding are not

capable of producing daughters with high production, or at least they have not done so thus far.

The above tables represent the detailed study of 1478 animals, thus giving sufficient numbers to establish certain facts. It is from this list of sires and families that any breeder may expect to materially improve his herd, and should help breeders in selecting successful herd sires.

SUMMARY

Yearly records are the most reliable test of actual production.

Total number of Advanced Registry daughters does not always mean prepotency for high producing daughters. Popular sires are not always prepotent sires of high producing daughters.

A large number of high producing daughters, as compared with total number of daughters, is the important essential.

Well bred animals of good individuality are essential to successful breeding.

TABLE III: *List of Sires Having One or More Equivalent to 1000 Pound Butterfat Daughters*

Rank	Name of Sire	No. A. R. O. daughters	No. proven sons	No. daughters dams of tested daughters	No. equivalent to 1000 lb. daughters	No. equivalent to 800 lb. daughters	No. equivalent to 600 lb. daughters	Year of birth
1	King Segis Pontiac Count..........	29	8	4	5	12	13	1911
2	King Hengerveld Aaggie Fayne.....	34	4	16	3	4	5	1908
3	Sir Pietertje Ormsby Mercedes.....	68	23	14	2	16	42	1907
4	King of the Pontiacs..............	251	160	80	2	14	25	1905
5	Pontiac Aaggie Korndyke..........	58	21	21	2	9	13	1905
6	King Pontiac Champion...........	94	25	25	2	8	22	1908
7	Friend Hengerveld DeKol B. Boy...	46	5	20	2	4	4	1901
8	Aaggie 3d's Wayne Paul DeKol.....	19	1	25	2	3	4	1900
9	Sir Veeman Hengerveld............	103	13	53	1	6	8	1904
10	King Walker.....................	67	25	25	1	5	10	1905
11	Colantha Johanna Lad............	126	92	33	1	4	9	1903
12	King Mead of Riverside...........	24	1	6	1	3	13	1908
13	Prince Gelsche Walker............	30	6	2	1	3	7	1910
14	Maplecrest Pontiac Hartog.........	26	4	4	1	3	4	1908
15	King Segis Beets..................	47	18	20	1	3	4	1906
16	Johanna Rue 3d's Lad.............	49	30	40	1	3	3	1899
17	Alcartra Polkadot Corrector........	22	17	21	1	3	9	1902
18	Sir Korndyke Hengerveld DeKol....	45	36	21	1	2	5	1905
19	Pontiac Korndyke.................	147	119	96	1	2	5	1898
20	Sir Johanna Canary DeKol.........	16	2	13	1	2	3	1906
21	King Beauty Pietertje DeKol.......	9	1	3	1	2	2	1907
22	Cornucopia Waukasha Prince.......	11	3	13	1	2	2	1904
23	McKinley Hengerveld DeKol.......	16	3	13	1	1	3	1907
24	Dutchland Sir Pietertje Hengerveld	23	13	5	1	1	3	1907
25	Pontiac Appollo..................	50	14	18	1	1	2	1905
26	Iowana Sir Ollie..................	2	0	0	1	1	2	1913
27	Sir Ormsby Skylark...............	11	1	8	1	1	2	1907
28	Ona Pontiac DeKol...............	1	0	0	1	1	1	1908
29	Flora Brank Paul Pledge...........	8	0	9	1	1	1	1903
30	Paul DeKol of Royalton...........	8	2	5	1	1	1	1903
31	Sir Hengerveld DeKol Abbekerk....	11	0	0	1	1	1	1908
32	Linden Butter Boy Pietertje........	9	0	6	1	1	1	1907
33	Butter Boy Segis Korndyke........	17	0	5	1	1	1	1908
34	Sir Jolie Johanna 4th.............	5	0	2	1	1	1	1903
35	Sir Ormsby Burke Segis...........	21	1	10	1	1	1	1908
36	Admiral Urmagal Burke...........	4	0	0	1	1	1	1913
37	SeKol Beets Segis 4th.............	9	1	1	1	1	1	1910
38	Soldene Beets Butter Boy..........	1	0	0	1	1	1	1910
39	Sir Hengerveld Clyde..............	1	0	0	1	1	1	1912
40	Leda Hengerveld Sir Piebe.........	3	0	2	1	1	1	1904

Table IV: *List of Sires Having Two or More Equivalent to 800 Pound Butterfat Daughters*

Rank	Name of Sire	No. A. R. O. daughters	No. proven sons	No. daughters dams of tested daughters	No. equivalent to 1000 lb. daughters	No. equivalent to 800 lb. daughters	No. equivalent to 600 lb. daughters	Year of birth
1	Sir Pietertje Ormsby Mercedes	68	23	14	2	16	42	1907
2	King of the Pontiacs	251	160	80	2	14	25	1905
3	King Segis Pontiac Count	29	8	4	5	12	13	1911
4	Pontiac Aaggie Korndyke	58	21	21	2	9	13	1905
5	King Pontiac Champion	94	25	25	2	8	22	1908
6	Sir Johanna Piebe	25	9	12	0	7	14	1907
7	Sir Veeman Hengerveld	103	13	53	1	6	8	1904
8	Spring Farm King Pontiac 6th	49	3	0	0	6	8	1911
9	King Walker	67	25	28	1	5	10	1905
10	Pietertje Hengerveld Sir Korn	17	6	6	0	5	10	1909
11	Colantha Johanna Lad	126	92	55	1	4	9	1903
12	King Hengerveld Aaggie Fayne	30	4	16	3	4	5	1908
13	Friend Hengerveld DeKol B. Boy	46	45	20	2	4	4	1901
14	Masterpiece	17	1	6	0	4	4	1910
15	Aaggie 3d Wayne Paul DeKol	19	1	25	2	3	4	1900
16	King Mead of Riverside	24	1	6	1	3	13	1908
17	Maplecrest Pontiac Hartog	26	4	4	1	3	5	1908
18	Prince Gelsche Walker	30	6	2	1	3	7	1910
19	King Segis Beets	47	18	20	1	3	4	1906
20	Johanna Rue 3d's Lad	49	30	40	1	3	3	1899
21	Sir Hengerveld Model Johanna	20	9	13	0	3	9	1905
22	Sir Paul Veeman Hengerveld	16	0	3	0	3	8	1911
23	Juliana King of Riverside	16	9	14	0	3	7	1904
24	Sir Inka DeKol Chief	10	0	3	0	3	6	1907
25	Colantha Johanna Champion	55	27	0	3	3	5	1906
26	Woodcrest Pietje Walker	6	0	0	0	3	4	1912
27	Ormsby Korndyke Lad	31	4	4	0	3	4	1910
28	Johanna Beets	5	0	10	0	3	3	1909
29	Alcartra Polkadot Corrector	22	17	21	1	2	9	1902
30	Sir Korndyke Hengerveld DeKol	45	36	21	1	2	5	1905
31	Pontiac Korndyke	147	119	96	1	2	5	1898
32	Sir Johanna Canary DeKol	16	2	13	1	2	3	1906
33	King Beauty Pietertje DeKol	9	1	3	1	2	2	1907
34	Cornucopia Waukasha Prince	11	3	13	1	2	2	1904
35	Dutchland Colantha Sir Inka	69	12	37	0	2	14	1908
36	Ignaro DeKol	25	7	25	0	2	11	1897
37	Homestead Girl DeKol Sarc. Lad	107	45	63	0	2	8	1903
38	Quirinus Cornucopia	21	4	4	0	2	7	1907
39	Hygeia Veeman Butter Boy	12	1	6	0	2	6	1908
40	Admiral Walker Pietertje	60	16	38	0	2	6	1902
41	Sir Longfield DeKol	12	3	10	0	2	5	1904
42	Piebe Laura Ollie Homestead King	16	0	0	0	2	5	1913
43	Segis Pontiac DeKol Burke	24	3	0	0	2	5	1912
44	Cor-Will Colantha Paul DeKol	8	0	7	0	2	4	1907
45	King Pietertje Cloverdale	12	1	4	0	2	4	1910
46	Johanna de Pauline 2d's Lad	38	17	7	0	2	4	1900
47	Sir Fayne Concordia	27	27	22	0	2	4	1904
48	Judge Hengerveld DeKol	43	16	21	0	2	3	1906
49	Tidy Abbekerk Prince	91	16	50	0	2	3	1905
50	Cornucopia Pontiac Johanna Lad	19	2	4	0	2	3	1907
51	Sindt Butter Boy	22	5	4	0	2	3	1907
52	Walker Korndyke Segis	13	20	8	0	2	3	1907
53	Ononis Paul DeKol	4	0	5	0	2	2	1902
54	Wachusett Creamelle George	2	0	1	0	2	2	1906
55	King Segis Butter Boy	35	5	13	0	2	2	1905
56	Pontiac Hesseltje Korndyke	53	10	13	0	2	2	1903
57	Sir Korndyke Bess	8	0	0	0	2	2	1912
58	Sir Pietertje Ormsby Mercedes 14th	5	0	1	0	2	2	1911

TABLE V: *List of Sires Having Five or More Equivalent to 600 Pound Butterfat Daughters*

Rank	Name of Sire	No. A. R. O. daughters	No. proven sons	No. daughters dams of tested daughters	No. equivalent to 1000 lb. daughters	No. equivalent to 800 lb. daughters	No. equivalent to 600 lb. daughters	Year of birth
1	Sir Pietertje Ormsby Mercedes	68	23	14	2	16	42	1907
2	King of the Pontiacs	151	160	80	2	14	25	1905
3	King Pontiac Champion	94	25	25	2	8	22	1908
4	Dutchland Colantha Sir Inka	69	12	37	0	2	19	1908
5	Sir Johanna Fayne	49	8	16	0	1	17	1905
6	Sir Johanna Piebe	25	9	12	0	7	14	1907
7	King Segis Pontiac Count	29	8	4	5	12	13	1911
8	Pontiac Aaggie Korndyke	58	21	21	2	9	13	1905
9	King Meade of Riverside	24	1	6	1	3	13	1908
10	Johanna de Colantha Champion	28	10	11	0	0	12	1909
11	Ignaro DeKol	25	7	25	0	2	11	1897
12	King Walker	67	25	28	1	5	10	1905
13	Pietertje Hengerveld Sir Korn	17	6	6	0	5	10	1909
14	Aaggie Cornucopia Paul. Count 13th	22	1	12	0	1	10	1906
15	Woodcrest Tehee	16	0	2	0	1	10	1910
16	Colantha Johanna Lad	126	92	55	1	4	9	1903
17	Sir Hengerveld Model Johanna	20	9	13	0	3	9	1905
18	Alcartra Polkadot Corrector	22	17	21	1	2	9	1902
19	King Colantha Clothilde	29	24	11	0	0	9	1909
20	Emblagaard Tritomia Homestead	29	3	9	0	1	9	1909
21	Aggie Cornucopia Johanna Lad Jr.	61	34	28	0	0	9	1904
22	Sir Veeman Hengerveld	103	13	53	1	6	8	1904
23	Homestead Girl DeKol Sarc. Lad	107	45	63	0	2	8	1903
24	Spring Farm King Pontiac 6th	49	3	0	0	6	8	1911
25	Sir Paul Veeman Hengerveld	16	0	0	0	3	8	1911
26	King Segis Hengerveld Vale	13	4	2	0	0	8	1909
27	Prince Gelsche Walker	30	6	2	1	3	7	1910
28	Juliana King of Riverside	16	9	14	0	3	7	1904
29	Quirinus Cornucopia	21	4	4	0	2	7	1907
30	Star Farm Johanna Lad	14	3	2	0	0	7	1907
31	Sir Walker Segis	30	8	8	0	0	7	1907
32	Sir Inka DeKol Chief	10	0	3	0	3	6	1907
33	Hygeia Veeman Butter Boy	12	1	6	0	2	6	1906
34	Admiral Walker Pietertje	60	16	38	0	2	6	1902
35	Korndyke Queen DeKol Prince	90	25	61	0	1	6	1899
36	King Hengerveld Aaggie Fayne	30	4	16	3	4	5	1908
37	Maplecrest Pontiac Hartog	26	4	4	1	3	5	1908
38	Sir Korndyke Hengerveld DeKol	45	36	21	1	2	5	1905
39	Pontiac Korndyke	147	119	96	1	2	5	1898
40	Colantha Johanna Champion	55	27	20	0	3	5	1906
41	Sir Longfield DeKol	12	3	10	0	2	5	1904
42	Segis Pontiac DeKol Burke	24	3	0	0	2	5	1912
43	Piebe Laura Ollie Homestead King	16	0	0	0	2	5	1913
44	Piebe Champion	31	8	10	0	1	5	1908
45	King Palmyra Fayne	32	5	10	0	1	5	1910
46	Emblagaard Prince	21	1	5	0	0	5	1910
47	Canary Paul	27	22	13	0	0	5	1907
48	Paul Frenesta DeKol	47	2	10	0	0	5	1906
49	Butter Boy Sir Mechthilde	8	2	5	0	0	5	1904
50	Beauty Walker Pietertje King	26	1	10	0	0	5	1910
51	Pontiac Hengerveld Parthenea	84	30	52	0	0	5	1905
52	Pearl of the Dairy's Joe DeKol	76	10	59	0	0	5	1897

TABLE VI: *Genealogy Table*

Sir Henry of Maplewood (1–8–2*0–0–0)
1. Mechthilde Sir Henry of Maplewood (7–14–8*0–0–0)
1. Tirania's Sir Mechthilde (3–7–5*0–0-0)
Sir Abbekerk (0–0–0*0–0–0)
DeKol 2d Butter Boy (12–21–19*0–0–0)
1. Hengerveld DeKol (116–67–85*0–1–1)
1. Sir Korndyke Hengerveld DeKol (45–36–21*1–2–5)
1. King Korndyke Hengerveld Ormsby (60–18–10*0–0–0)
Ormsby Korndyke Lad (31–4–4*0–3–4)
2. Sir Korndyke Hengerveld DeKol 36th (8–6–0*0–0–2)
Sir Korndyke Bess (8–0–0*0–2–2)
2. Sir Hengerveld Model Johanna (20–9–13*1–1–3)
Sir Hengerveld Clyde (1–0–0*1–1–1)
3. Judge Hengerveld DeKol (43–16–21*0–2–3)
McKinley Hengerveld DeKol (16–3–13*1–1–3)
4. Woodcrest Nig DeKol (45–22–27*0–0–0)
Sir Hengerveld DeKol Abbekerk (11–0–0*1–1–1)
5. Pontiac Appollo (50–14–18*1–1–2)
6. Pontiac Hengerveld Parthenea (84–30–52*0–0–5)
2. DeKol Burke (78–48–61*0–1–1)
Piebe DeKol Burke (28–19–32*0–0–0)
1. Chief Piebe Oak Duchess (22–5–17*0–0–0)
Alcartra Polkadot Corrector (62–17–21*1–2–9)
2. Leda Hengerveld Sir Piebe (3–0–2*1–1–1)
3. Baron Pauline DeKol (13–2–11*0–0–0)
Sir Piebe DeKol (10–5–11*0–0–0)
Almeda Luecke 2nd's Piebe DeKol (7–15–8*0–0–0)
Sir Longfield DeKol (12–3–10*0–2–5)
4. Pietertje Hengerveld Count DeKol (99–59–69*0–0–0)
Dutchland Sir Pietertje Hengerveld (23–13–5*1–1–3)
2. Empress Josephine 3d Sir Mechthilde (3–8–10*0–0–0)
Manor Josephine DeKol (6–5–4*–0–0–0)
Pontiac Korndyke (147–119–96*1–2–5)
1. King of the Pontiacs (251–160–80*2–14–25)
1. King Pontiac Champion (94–25–25*2–8–22)
2. Spring Farm King Pontiac (39–24–5*0–0–3)
Spring Farm King Pontiac 6th (49–3–0*0–6–8)
3. Cornucopia Pontiac Johanna Lad (19–2–4*0–2–3)
2. Pontiac Aaggie Korndyke (58–21–21*2–9–13)
Maplecrest Pontiac Hartog (26–4–4*1–3–4)
Ona Pontiac DeKol (1–0–0*1–1–1)
3. Pontiac Hesseltje Korndyke (53–10–33*0–2–2)
2. Sir Mechthilde of Maplewood (2–3–2*0–0–0)
Mercedes Mechthilde Pietertje (8–22–11*0–0–0)
Jack Mercedes (6–2–7*0–0–1)
Sir Pietertje Ormsby Mercedes (68–23–14*2–16–42)
Sir Pietertje Ormsby Mercedes 14th (5–0–1*0–2–2)
Neptune Jr. (0–0–0*0–0–0)
DeKol 2d Prince (0–0–0*0–0–0)
Paul DeKol (38–25–29*0–0–0)
1. Paul Mutual DeKol (3–8–6*0–0–0)
1. Johanna Rue 2d's Paul DeKol (33–14–33*0–0–0)
Mercedes Julip's Pietertje Paul (89–36–53*0–0–0)
King Segis (87–85–60*0–0–0)
1. King Segis Pontiac (122–59–29*0–1–1)
1. Butter Boy Segis Korndyke (17–0–5*1–1–1)
2. King Segis Pontiac Count (29–8–4*5–12–13)
3. King Segis Pontiac Emperor (11–7–3*0–0–1)
Segis Pontiac DeKol Burke (24–3–0*0–2–5)
2. King Segis Beets (47–18–20*1–3–4)
3. King Fayne Segis (28–27–19*0–0–0)
1. Masterpiece (17–1–6*0–4–4)
2. King Hengerveld Aaggie Fayne (30–4–16*3–4–5)
3. King Palmyra Fayne (32–5–10*0–1–5)
4. King Segis Butter Boy (35–5–13*0–2–2)
5. King Segis Hengerveld Vale (13–4–2*0–0–8)

TABLE VI: *Genealogy Table—(Continued)*

6. Sir Ormsby Burke Segis (21–1–10*1–1–1)
7. Sir Walker Segis (30–8–8*–0–0–7)
8. Walker Korndyke Segis (13–20–8*0–2–3)
9. DeKol Beets Segis (35–13–24*0–0–3)
DeKol Beets Segis 4th (9–1–1*1–1–1)
2. Paul Johanna DeKol (5–3–9*0–0–0)
Pearl of the Dairy's Joe DeKol (76–10–59*0–0–5)
3. Paul DeKol Clothilde (12–3–2*0–0–0)
Johanna 5th Paul DeKol (1–3–4*0–0–0)
Ignaro DeKol (25–7–25*0–2–11)
4. Johanna Rue 2d Paul DeKol (33–14–33*0–0–2)
Canary Mercedes Johanna DeKol (16–9–12*0–0–0)
Inka Clothilde Mercedes Prince (17–7–16*0–0–1)
Sir Inka DeKol Chief (10–0–3*0–3–6)
2. Count Paul DeKol (8–11–13*0–0–0)
1. Pauline Paul's 2d Count (20–16–17*0–0–0)
Aaggie Cornucopia Pauline Count (90–49–39*0–0–0)
1. Aaggie Cornucopia Pauline Count Jr. (7–3–9*0–1–1)
2. Cornucopia Waukasha Prince (11–3–13*1–2–2)
3. Aaggie Cornucopia Pauline Count 13th (22–1–12*0–1–10)
2. A & G Paul DeKol Butter Boy (9–2–10*0–0–0)
Fidessa Butter Boy (7–6–7*0–0–1)
Juliana King of Riverside (16–9–14*0–3–7)
King Mead of Riverside (24–1–6*1–3–13)
3. Paul DeKol Jr. (23–25–21*0–1–1)
1. Homestead Jr. DeKol (73–39–71*0–0–2)
1. Sir Fayne Concordia (27–27–22*0–2–4)
1. Sir Johanna Ruth (32–5–16*0–0–0)
Sir Johanna Piebe (25–9–12*0–7–14)
2. Sir Johanna Fayne (49–8–16*0–1–17)
3. Colantha Johanna Champion (55–27–20*0–3–5)
1. Johanna de Colantha Champion (28–10–11*0–0–12)
2. Piebe Champion (31–8–10*0–1–5)
2. Emblagaard Tritomia Homestead (29–3–9*0–1–9)
2. Homestead Hengerveld DeKol Paul (29–12–31*0–0–0)
Ononis DeKol Paul (4–0–5*0–2–2)
4. Mutual Friend 3d's Paul (17–25–19*0–0–0)
1. Flora Brank's Mutual Friend Paul (10–7–14*0–0–0)
Flora Brank Paul Pledge (8–0–9*1–1–1)
2. DeKol 2d Mutual Paul (49–40–36*0–1–2)
1. Mutual Pietertje Paul (30–22–15*0–1–1)
Paul Frenesta DeKol (47–2–10*0–0–5)
2. Mooie Mutual DeKol (35–20–33*0–0–0)
Fobes Tritomia Mutual DeKol (38–31–26*0–0–2)
Oak DeKol 2d Homestead Fobes (12–7–4*0–0–2)
Oak DeKol Ollie Homestead (15–3–3*0–1–3)
Piebe Laura Ollie Homestead King (16–0–0*0–2–5)
5. Paul DeKol 3d (13–12–17*0–0–0)
1. Aaggie 3d's Wayne Paul DeKol (19–1–25*2–3–4)
2. Sir Veeman Hengerveld (103–13–53*1–6–8)
Sir Paul Veeman Hengerveld (16–0–0*0–3–8)
6. Nelly Grant 4th Paul DeKol (20–1–67*0–0–0)
Sir Paul DeKol Clothilde (4–2–2*0–0–0)
Calamity Jane's Paul (18–20–16*0–0–0)
Calamity Jane's Paul A (29–9–31*0–0–0)
Canary Mercedes Paul (28–14–25*0–0–4)
Sir Johanna Canary DeKol (16–2–11*1–2–3)
Ononis DeKol Paul (4–0–5*0–2–2)
7. DeKol 2d Paul DeKol (45–37–35*0–0–0)
Pietertje Hengerveld's Paul DeKol (16–30–14*0–0–0)
1. Gem Pietertje Paul DeKol (25–16–27*0–0–0)
Sir Ormsby Hengerveld DeKol (69–26–42*0–1–4)
Sir Ormsby Skylark (11–1–8*1–1–2)
2. Canary Paul (27–22–13*0–0–5)
Canary Paul Fobes Homestead (46–28–16*0–0–2)
Iowana Sir Ollie (2–0–0*1–1–2)

TABLE VI *Genealogy Table—(Concluded)*

Netherland Prince (0–0–0*0–0–0)
  1. Netherland Alban (1–3–5*0–0–0)
      DeKol 2d Netherland (22–21–29*0–0–0)
        Manor DeKol (34–25–28*0–0–0)
          1. Lorraine Prince (0–0–0*0–0–0)
              Korndyke Queen DeKol's Prince (90–25–61*0–1–6)
          2. DeKol 2nd Butter Boy 3d (119–95–87*0–1–4)
              1. Friend Hengerveld DeKol Butter Boy (46–45–20*2–4–4)
              2. Sir Korndyke Manor DeKol (51–43–28*0–0–0)
                  Faforit Tritomia Sir Korndyke (10–10–7*0–0–0)
                    Pietertje Hengerveld Sir Korndyke (17–6–6*0–5–10)
              3. Hygeia Veeman Butter Boy (12–1–6*0–2–6)
              4. Butter Boy Pietertje (47–30–44*0–0–1)
                  1. Linden Butter Boy Pietertje (9–0–6*1–1–1)
                  2. Butter Boy Sir Mechthilde (8–2–5*0–0–5)
              5. Creamelle DeKol Butter Boy (10–7–6*0–0–0)
                  Wachusett Creamelle George (2–0–1*0–2–2)
              6. DeKol Hengerveld Burke (39–32–28*0–0–0)
                  Sir Urmagal Burke (53–9–17*0–1–2)
                    Admiral Urmagal Burke (4–0–0*1–1–1)
              7. Pontiac Soldene Butter Boy (6–3–4*0–0–0)
                  Soldene Beets Butter Boy (1–0–0*1–1–1)
  2. Netherland Statesman (0–0–0*0–0–0)
      Clothilde 3d's Netherland (1–3–7*0–0–0)
        Maurice Clothilde (1–3–6*0–0–0)
          Maurice Bonheur (3–2–8*0–0–0)
              Sarcastic Lad (34–38–27*0–0–0)
                1. Johanna Aaggie Sarcastic Lad (18–25–28*0–0–0)
                  1. Homestead Girl DeKol Sarcastic Lad (107–45–63*0–2–8)
                      1. Woodcrest Tehee (16–0–2*0–1–10)
                      2. Star Farm Johanna Lad (14–3–2*0–0–7)
                      3. Pietje 22nd Son (32–8–7*0–0–4)
                          Woodcrest Pietje Walker (6–0–0*0–3–4)
                  2. Aaggie Cornucopia Johanna Lad (107–76–86*0–1–1)
                      1. Sir Tehee Cornucopia (31–7–15*0–0–0)
                          Quirinus Cornucopia (21–4–4*0–2–7)
                      2. Johanna Beets (5–0–10*0–3–3)
                      3. Aaggie Cornucopia Johanna Lad Jr. (61–34–28*0–0–9)
                2. Colantha Johanna Lad (126–92–55*1–4–9)
                  1. Dutchland Colantha Sir Inka (69–12–37*0–2–19)
                  2. King Colantha Clothilde (29–24–11*0–0–0)
                      1. Emblagaard Prince (21–1–5*0–0–5)
                      2. Beauty Walker Pietertje King (26–1–10*0–0–5)
                3. Johanna Rue 3d's Lad (49–30–40*1–3–3)
                4. Johanna de Pauline 2nd's Lad (38–13–37*0–2–4)
                5. Colantha 4th's Lad (25–21–21*0–0–3)
                    Gerben's Colantha Lad (16–3–3*0–0–0)
                      Cor-Will Colantha Paul DeKol (8–0–7*0–2–4)
                6. Johanna DeKol's Lad (33–6–18*0–0–0)
                    Johanna DeKol 2d's Lad (20–13–25*0–0–0)
                        Sir Jolie Johanna (19–5–9*0–0–1)
                            Sir Jolie Johanna 4th (5–0–2*1–1–1)

Dam by Paul DeKol (38–25–29*0–0–0)
  Pauline Paul of Portage DeKol (2–6–5*0–0–0)
    Paul DeKol of Royalton (8–2–5*1–1–1)

Admiral Walker (6–4–6*0–0–1)
  Admiral Walker Pietertje (60–16–38*0–2–6)
    1. King Walker (67–25–28*1–5–10)
    2. Admiral Walker Gelsche (49–16–17*0–0–0)
        Dam of Prince Gelsche Walker (30–6–2*1–3–7)
        by Admiral Walker Gelsche

King Pietertje Cloverdale (12–1–4*0–2–4)
  Great grandson of DeKol 2d's Paul DeKol and Sarcastic Lad

Tidy Abbekerk Prince (91–16–50*0–2–3)
        and
King Beauty Pietertje DeKol (9–1–3*1–2–2)
  Trace in the 4th generation to Mechthilde Sir Henry of Maplewood

- King Segis Pontiac Count, 93909 (25–8–4)
  - King Segis Pontiac, 44444 (122-59-29)
    - King Segis, 36168 (87–85–60)
      - Mercedes Julip's Pietertje Paul, 29830 (89–36–53)
        - Johanna Rue 3d's Paul De Kol, 21724 (33–14–32)
        - Mercedes Julip's Pietertje 39480 29.36 lb. butter.
      - & G. Inka McKinley 55163 29.62 lb. butter
        - Billy McKinley, 23378 (5–2–4)
        - Segis Inka, 36617 28.04 lb. butter
    - Pontiac Clothilde De Kol 2d, 69991 12.71 lb. butter
      - Pontiac Korndyke 25982 (147–119–96)
        - Manor Josephine De Kol, 22779 (6-5-4)
        - Belle Korndyke, 13913 25.77 lb. butter.
      - Pontiac Clothilde De Kol, 49657 23.11 lb. butter
        - Hengerveld De Kol, 23102 (116–67–85)
        - Rag Apple's Clothilde Artis, 34741 12.53 lb. butter
  - K. P. Lilith Clothilde 110228 1043 lb. butter
    - King of the Pontiacs, 39037 (251–160–80)
      - Pontiac Korndyke, 25982 (147–119–96)
        - Manor Josephine De Kol, 22779 (6–5–4)
        - Belle Korndyke, 13913 25.77 lb. butter
      - Pontiac Lunde Hengerveld, 51585 28.41 lb. butter
        - Hengerveld De Kol, 23102 (116–67–85)
        - Lunde Beauty, 34745 11.84 lb. butter
    - Lilith Clothilde
      - Lilith Pauline De Kol's Count, 28430 (95–56–74)
        - Pauline Paul 2d's Count, 22902 (20–16–17)
        - Lilith Pauline De Kol, 43434 28.24 lb. butter
      - Clothilde Pietertje Boon, 61391
        - Lamb De Kol Pietertje Boon, 27347 (1–0–5)
        - Maggie Lamb, 39025

- Sir Pietertje Ormsby Mercedes (68–23–14)
  - Jack Mercedes, 35077 (6–2–7)
    - Mercedes Mechthilde Pietertje, 25795 (8–22–11)
      - Sir Mechthilde of Maplewood, 23448 (2–3–2)
        - Sir Henry of Maplewood (1–8–2)
        - Lady Aaggie Flora
      - Mercedes Julip's Pietertje, 39480 29.36 lb. butter
        - Elaine's Pietertje 20854 (1–0–1)
        - Mercedes Julip
    - Sadie Mechthilde, 60968
      - Chief Josephine Mechthilde, 26483 (1–3–4)
        - Second Sir Josephine Mechthilde, 24478 (2–3–2)
        - Beechwood Bessie (32 W.H.F.A.)
      - Aaltje Maid, 51525
        - Sir Aaggie Colantha, 24412
        - Winnebago Belle (1200 W.H.F.A.)
  - Pietertje Maid Ormsby, 78051 35.56 lb. butter
    - Sir Ormsby Hengerveld De Kol, 31212 (69–26–42)
      - Gem Pietertje Hengerveld's Paul De Kol, 23300 (25–16–27)
        - Pietertje Hengerveld's Paul De Kol 16–30–14
        - Maplecroft Gem, 35909 20.10 lb. butter
      - Duchess Ormsby 2d, 35439 21.31 lb. butter
        - Tritomia Netherland Carl, 16406 (7–2–16)
        - Duchess Ormsby
    - Pietertje Maid of Grouw 3d, 53646 18.45-lb. butter
      - De Kol 2d Paul DeKol No. 2, 23366
        - Paul De Kol (38–25–29)
        - May Hartog of Brookside
      - Pietertje Maid of Grouw, 42832 13.00 lb. butter
        - Jeltje S. Netherland's Pietertje, 15927 (7–3–7)
        - Maid Mercedes of Grouw

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A HANDFUL OF ANDES BERRIES

These luscious fruits, which resemble loganberries in character but are somewhat sweeter and richer in flavor, are produced by an immense, raspberry-like bramble which grows wild in the region between southern Mexico and Peru, and is cultivated in Colombia and Ecuador. They can probably be grown in several parts of the United States, and in addition, the species should be of great interest to plant breeders for crossing with our cultivated raspberries. The specimens here shown, slightly reduced in size, were picked from wild plants on the volcano Irazú, in Costa Rica. (Frontispiece.)

THE ANDES BERRY

Wilson Popenoe
Agricultural Explorer, United States Department of Agriculture

SCATTERED throughout the highlands of tropical America, mainly at elevations between 4,000 and 10,000 feet, are many species of Rubus, some of which produce excellent fruits. Few of them, however, are seen in cultivation, though the juicy berries of a dozen or more are sometimes gathered from wild plants and carried to the markets of large cities such as Guatemala, Bogotá, and Quito.

Rubus glaucus Benth., the Andes berry (as it may well be called, after the region in which it grows most abundantly) is certainly one of the most valuable. This species occurs as a wild plant in several countries, and is cultivated in at least two,—Colombia and Ecuador. That a fruit of such excellent quality should have escaped the attention of North American horticulturists until very recently seems difficult of explanation. Unlike the Colombian berry (*Rubus macrocarpus*), described in a recent number of the Journal of Heredity, its distribution is not limited to a narrow and rather inaccessible zone in the higher Andes: not only is it common as a wild plant throughout an extensive area, but it is also abundant in the gardens of numerous towns and villages.

In character of growth and foliage this species closely resembles the black raspberry, while the fruits are more like our blackberries in character. For this reason it does not seem proper to call it the "Andes raspberry," nor yet the "Andes blackberry." The canes, which are trailing to half-erect, are covered with whitish bloom, and root freely at the tips; the leaves are trifoliate, like those of the black raspberry; and the fruit-clusters are similar to those of the latter. The luscious fruits, in place of pulling off (separating from the torus or receptacle) as do our raspberries, must be picked like blackberries. The receptacle remains firmly attached within the fruit, and the calyx adheres to its base.

In this connection, it is worthy of mention that the Colombian berry presents conditions just the reverse of this. Its canes, leaves, and flowers resemble those of our northern blackberries, while its huge fruits are raspberries, if judged by our present standard, since they pull off the torus when fully ripe, leaving the latter attached to the plant. In other words, the Andes berry is a raspberry in growth but a blackberry in fruit, while the Colombian berry is a blackberry in growth and a raspberry in fruit. Our present classification will have to be altered somewhat if it is to include these tropical American species.

A VARIABLE SPECIES

Traveling down the Andes in search of new food-plants for introduction into the United States, I was much interested by the wide range of variation exhibited by plants, both wild and cultivated, of *Rubus glaucus*.[1] Differences in the size, color, and quality of the fruits were particularly striking. Some of the varieties are, to my mind, superior to our northern raspberries in flavor, as well as in size.

I had picked many of these berries from wild plants in the mountains, and had enjoyed them; but a full ap-

[1] Since this species is not well known to North American botanists, I append the following brief characterization: Canes trailing to suberect, up to 5 m. long; branches, panicles, and petioles glabrous, glaucus-pruinose, armed with recurved thorns; leaves pinnately trifoliate, the leaflets ovate-lanceolate, long-acuminate, glabrous above and white tomentose beneath; flowers about 2 cm. broad, in few-flowered leafy panicles, the sepals long-acuminate, petals white, nearly as long as the sepals; fruits oblong to cordate, 2 to 4 cm. long, light to dark purplish red, composed of numerous drupelets which are pilose when immature.

preciation of their rich flavor, juiciness, and freedom from objectionable seeds did not come until I was served, at Charles J. Eder's home in the beautiful Cauca valley of Colombia, a saucer of thoroughly ripe ones, with cream and sugar. The scarcity of the former article in the Andean region makes it difficult for the agricultural explorer to test such fruits as blackberries and raspberries under conditions comparable with those to which he is accustomed in the United States. There are, I believe, a number of berries in the Andes which would compare favorably with our own, if served in the same fashion; but when one buys them in the market, picked before fully mature and badly bruised in transit, and eats them without the customary concomitants, he is not certain to appreciate them at their full value.

I first came upon the Andes berry in the highlands of northern Guatemala. Here it is found, in the region of Coban, at elevations of 4,000 to 6,000 feet. It is not abundant, as it is in northern South America, nor have I ever seen plants of such large size as in the latter region. Indeed, in Guatemala it usually occurs in the form of a straggling or trailing bush not over six or eight feet in height. It frequents clay soils, and open, sunny places.

The fruits produced by these wild plants in Guatemala (for I never saw it cultivated in that country) are oblong, up to an inch and a half in length, and dark maroon. They remind one of loganberries, except that they are broader in form and somewhat sweeter in taste. They have small, soft seeds, and are very juicy. The flavor is rich and delicious. The Indians, as they wander over the mountainsides, gather and eat them, but the quantity available is never large enough to warrant carrying the fruit to market, at least, I have never seen it on sale in any of the Guatemalan towns. The Kekchi know this berry as *uuk-tokan;* the latter word is applied to several species of Rubus, and the prefix *uuk* is used to designate this particular one. We have here, in fact, another example of the remarkable binomial nomenclature employed by the Guatemalan Indians of Maya descent, a system which recognizes botanical relationships, in a limited way, and which probably has been in existence since long before the Conquest.

In Costa Rica I again found the plant, growing abundantly upon the slopes of the volcano Irazú at elevations between 6,000 and 7,000 feet. In certain places it forms solid stands, twenty or thirty yards in diameter. The plants are suberect in habit, and reach about six feet in height. The fruits are different from those seen in Guatemala, being somewhat smaller, lighter red in color, and not so rich in flavor. Botanical specimens collected here, however, prove that the plant is not specifically different from the one studied in Guatemala, hence we can only conclude that we are dealing with a variation such as those which give rise to horticultural forms.

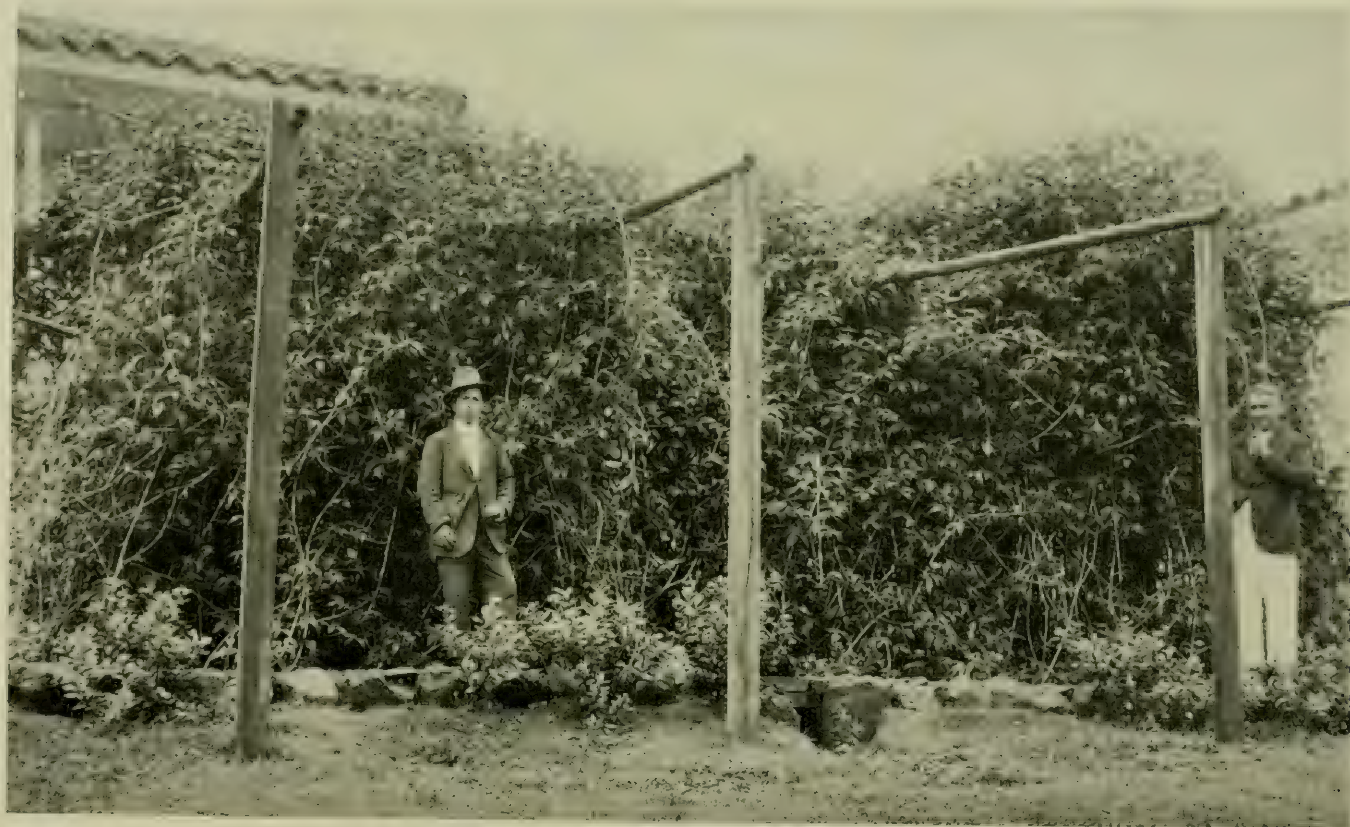
ABUNDANT IN COLOMBIA

Upon reaching the highlands of Colombia, in the department of Cundinamarca, I again found *Rubus glaucus* growing as a wild plant, and here, for the first time, I saw its luscious fruits offered in the markets. In the city of Bogotá they can be obtained during a large part of the year; they are sold under the name of *mora de Castilla,* which does not, however, serve to distinguish them from the fruits of other species of Rubus, since several which grow wild in this region are commonly sold under the same name. The use of the term *mora*, originally meaning *mulberry* in Spanish, has been extended in Latin America to include many fruits of the genus Rubus. To indicate a variety of superior quality the Colombians generally add the phrase *de Castilla* (*Castilian*), a usage which has come down from Colonial days, when the best of everything was supposed to come from the Mother Country.

The plant is found in considerable abundance upon the mountainsides not far from Bogotá, mainly at eleva-

FOLIAGE, FLOWERS AND FRUIT, NATURAL SIZE

In character of growth the Andes berry is similar to our cultivated raspberries: the canes are glaucous, the leaves trifoliate (although the few shown above, arising from a flower-panicle, are simple) and the flowers white. The fruit, however, does not separate from the torus or receptacle, as does the raspberry, but more closely resembles our blackberries in character. Photographed at Ambato, Ecuador. (Fig. 1.)



TWO PLANTS IN WESTERN COLOMBIA

To plant breeders, the unusual vigor of the Andes berry is of great interest, as offering a valuable characteristic for combination, by means of hybridization, with our cultivated raspberries. The tangled mass of foliage shown above is derived from two plants growing in the grounds of the American Hospital at La Cumbre, near Cali, in western Colombia. It seems probable that more berries would be produced if the plants were pruned for the production of fruiting laterals, instead of being allowed to develop unchecked as is invariably the case in South America. (Fig. 2.)

A CLUSTER OF IMMATURE ANDES BERRIES, AND A SINGLE MATURE ONE

The fruits are borne on leafy panicles, and when fully ripe are light red to deep maroon in color, soft and juicy in texture, with small, soft seeds. Although the species has not had the benefit of intelligent cultivation with a view to improving the size and quality of the fruit, Andes berries are perhaps superior to most of our cultivated raspberries in flavor and quality. The fruits here shown, natural size, were produced by cultivated plants at Ambato, Ecuador. (Fig. 3.)

tions of 6,000 to 8,000 feet. The fruits appeared to me somewhat darker in color than most of those I had seen in Costa Rica, but not quite so large, soft, and luscious as those of northern Guatemala. I saw no plants in cultivation in this part of Colombia, but after crossing the Quindio pass and traveling up the Cauca valley, I found at La Cumbre, a small station on the railroad between Cali and the Pacific port of Buenaventura, a few plants growing in the garden of an American hospital. This was the first time I had seen the species in cultivation, but I was soon to become familiar with it in Ecuadorean gardens. Here at La Cumbre (elevation about 5,200 feet), in the western cordillera of the Andes, I was impressed by the luxuriant growth which the species makes when brought into cultivation. Two specimens covered a huge arbor 25 feet long by 10 feet in breadth and height, and furnished enough fruit to supply the hospital staff with excellent sauce and jelly. Yet I am convinced that much more fruit would be produced if the plant were systematically pruned. Fruiting laterals are not developed in great abundance by these huge plants; most of the fruit must therefore be borne on terminal clusters, which can never be very numerous.

It is in Ecuador that the Andes berry is best known, and horticulturally most important. Two towns, in particular, are noted for it: these are Ambato (8,500 feet) and Otavalo (8,100 feet). In both of these, plants are found in nearly every garden, and the fruit appears commonly in the markets; it is available throughout a large part of the year and is much used in the preparation of conserves and of a heavy syrup from which a refreshing drink is made. Otavalo is noted for this latter product.

I have seen, in Ecuador, two well-defined varieties of this berry, and have heard of a third. The common sort is deep maroon, about like the form observed in Guatemala, though slightly different in flavor, as far as I can compare the two by recollection. The second kind is light red—almost rose red—and is of a milder flavor than the common sort. The third one is said to be light pink, and for this reason is called *mora blanca* (white mora).

As in Colombia, the species occurs abundantly in Ecuador as an indigenous plant. I have seen it most commonly at elevations between 8,000 and 10,000 feet. In the wild state it is rarely over six or eight feet high, and not particularly vigorous in growth; but when brought into cultivation I have seen a single specimen cover the side of a small house, or reach several feet above a garden wall ten feet high.

CULTURAL NEEDS

In Ecuador, although it ranks as a cultivated plant, very little attention is given to its cultural requirements, and we can learn but little from an examination of the methods used by Ecuadorean horticulturists. No pruning is done, though it seems reasonable to believe that careful attention to this subject would result in far greater yields of fruit. It must be admitted that even the most productive plants observed in Ecuadorean gardens bear small crops, when compared with northern blackberries or raspberries. Probably this is largely due to the circumstance that they are allowed to develop too much wood, and are not pruned for the production of fruiting laterals.

I have seen wild plants upon clay soil, light sandy loam of volcanic origin, and rich alluvial loam. In northern Guatemala, they occur in a region where the rainfall is between 80 and 120 inches per annum, and is distributed through not less than ten of the twelve months. In Ecuador, on the other hand, they are sometimes found in places where the annual rainfall is not more than 15 or 20 inches.

Plants sent from Guatemala to the United States have been winter-killed at Washington, D. C., as would be expected of a species from an elevation of 5,000 feet in the latitude of the Central American countries. In Ecuador, wild plants are occasionally seen

at elevations of 10,000 to 11,000 feet, where light frosts are experienced; but it is not to be anticipated that the Andes berry will succeed in parts of the United States which are too cold for the loganberry. More probably its cultivation will be limited in this country to the Pacific Coast states, Arizona, New Mexico, and parts of Texas. Particular attention may be directed to its value for plant breeders: because of its vigor, and the large size and good quality of its fruit, it seems likely to prove an excellent subject for crossing with some of our northern raspberries.

THE USE OF THE GREENHOUSE IN CORN BREEDING

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THE improvement of corn by selection within self-fertilized lines necessarily is a slow process, and any method that will shorten the time required is highly desirable. It has been shown that sweet corn is adapted for forcing under glass.[1] The greenhouse also has been used successfully in inheritance studies with corn as shown by casual reference in several articles. The author is informed by Mr. G. N. Collins, however, that attempts to grow corn during the winter—that is, planted in the fall—in the greenhouse have not been successful. The plants under such conditions have failed to develop normally and have ripened prematurely with a scanty production of seed. The following notes indicate that under some conditions such practice is entirely successful. The determining differences are not known, and these notes are offered to indicate the practicability of this method, with the hope that interest in the possibilities of greenhouse culture may be promoted.

USE OF THE GREENHOUSE

The crop was grown in one of the department greenhouses at the Arlington Farm, Rosslyn, Virginia, during the winter of 1920-21. The center space was excavated to a depth of 12 inches and filled with good soil. Under greenhouse conditions the secondary roots of corn frequently originate abnormally near, and in extreme cases even above, the soil surface. To nullify the effect of this tendency the seed was planted in the bottom of a 6-inch furrow which was not filled in until the root system had become well established. This method proved very effective.

After emergence the plants were thinned to a stand that provided 1.67 square feet per plant. This is at the rate of over 25,000 plants per acre, and was entirely too thick, as, although there was plenty of moisture and fertility, it interfered with proper light distribution. It is thought that a rate allowing three square feet per plant would utilize the space to good advantage.

The following strains were grown: 8 plants of Gerrick that had been self-fertilized for five generations; 24 plants of a Chinese dent variety, self-fertilized for one generation; and 20 plants of a chlorophyll-deficient, brachytic strain of U. S. Selection No. 201 that had been self-fertilized for three generations. Two ears were obtained from the Gerrick, none from the No. 201, and a few seeds on each of three cobs from the Chinese variety.

There also were 116 plants from 58 F_1 crosses between self-fertilized strains of U. S. Selection No. 201. The following notes refer to these cross-bred plants.

[1] Rane, F. W. Green Corn Under Glass. N. H. Agr. Expt. Sta. Bull. 60. 1899.

CORN PLANTS IN THE GREENHOUSE AT ARLINGTON FARM, VA.

Under some conditions the growing of corn, for experimental purposes, in greenhouses has been found practicable. This method shortens the time necessary for the plants to mature. The photograph shows some crossbred plants of U. S. Selection 201 grown at the Arlington Farm in the winter of 1920–21 photographed 105 days after emergence. (Fig. 4.)

GREENHOUSE-GROWN CORN

These fifty-four ears were produced by the plants shown in Fig. 4. The flowers were pollinated by hand; although the ears are small, the seeds are well-developed, "the average weight of 100 from each ear being 28.5 grams in comparison with an average of 28.9 grams per 100 seeds of the parents." These ears were harvested 153 days after the emergence of the plants. (Fig. 5.)

Emergence was complete on October 19, 7 days after planting. The temperature was maintained at from 70° to 90° F. during the day and at from 68° to 70° F. at night. Under these temperatures and with the unusually bright weather that obtained during the winter, the plants developed rapidly, and were 32 to 40 inches high on November 26, 38 days after emergence. The plants silked between January 7 and 21, or in from 80 to 94 days after emergence. In contrast, the parent strains silked in from 65 to 79 days after planting, when grown under field conditions in Arkansas in 1920. The plants grown in the greenhouse were vigorous and attained a good size. This is shown in Fig. 4, which gives a general view of the house on January 31. The cross braces in this illustration are six feet high.

The 54 hand-pollinated ears shown in Fig. 5 were harvested on March 21, 153 days after the plants emerged. Thirty-eight of these ears were self-fertilized, and although small, there were enough seeds to answer the purpose. The seeds were well developed, the average weight of 100 from each ear being 28.5 grams, in comparison with an average of 28.9 grams per 100 seeds of the parents. Kernels from these selfed ears have been planted, have given as good a stand as field grown seed, and will be used as the basis for a second cycle of selection within self-fertilized lines. The use of the greenhouse, therefore, has saved a full year in the accomplishment of the breeding program.

DISCUSSION

The greenhouse does not seem to offer much usefulness in the earlier years of selection from a commercial variety of corn. The percentage of culls is so large during these years that field conditions seem essential to provide enough material for selection. However, in later years there are many phases of the corn breeding problem that suggest themselves as being adapted to greenhouse manipulation, and it seems that if breeding operations were on any considerable scale, the maintenance of greenhouse facilities for annual use in connection with them would be entirely warranted.

The height of the corn plant, its need for abundant room, and the necessity for maintaining relatively high temperatures, require the provision of special facilities planned for this particular crop. The best type of house is one that has no side benches and has as low a solid wall as possible. The light requirement seems of the

greatest importance, and such a house would allow utilization of the full supply. The results of Garner and Allard[2] suggest, too, that artificial lighting may be used to supplement the natural supply, and to obtain the optimum relation between periods of light and dark.

The details are for the future. For the present it seems enough to point out the advantages of speeding up the progress by growing two crops a year, and the desirability of determining the best practice in greenhouse corn culture as well as the possibilities and limitations of such a method in corn breeding.

WAXY ENDOSPERM IN COIX AND SORGHUM

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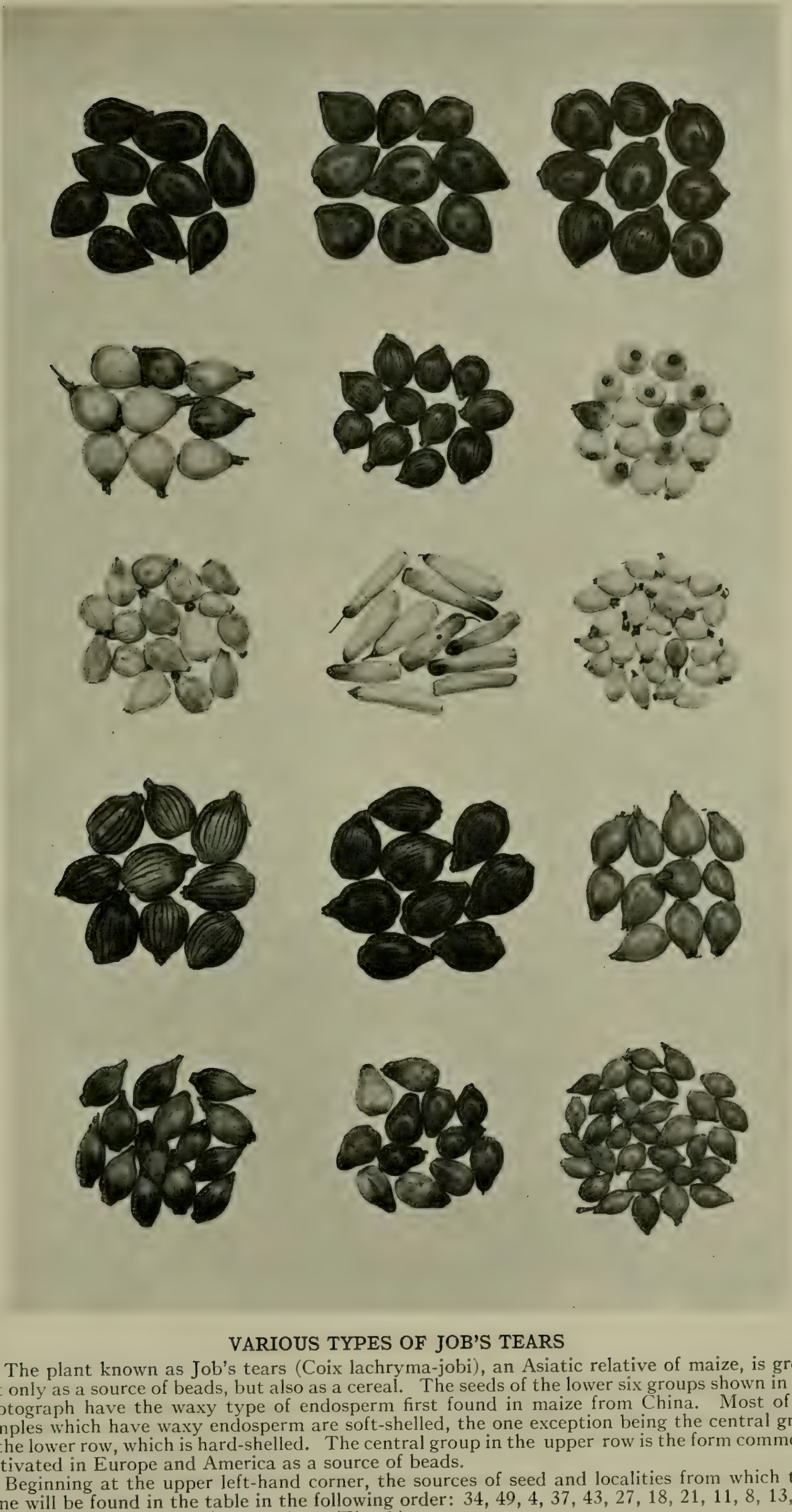
IN THE endosperm of maize seeds, a layer of compact starch cells, variable in thickness, encloses the loose or soft starch cells that occupy the center of the seed adjacent to the embryo. This layer of compact or hard starch cells is found in three visibly different, genetically distinct types, commonly known as horny, sweet, and waxy. Each of these types is distinguished easily from the others and from the soft type or central starch. The horny type is coextensive with maize and is the common form of endosperm, not only in maize but in most grasses. The sweet and waxy types have been reported only in maize and are restricted in distribution—the former in the Americas, and the latter in Asia. Sweet endosperm is distinguished from the common, horny form, chiefly in the wrinkling of the seed caused by the drying of imperfect starch cells. In the smaller seeded grasses, this characteristic wrinkling might be overlooked easily, or be attributed to immaturity or imperfect fertilization. However, crosses between maize with sweet endosperm and Euchlaena, the nearest American wild relative, have given only horny seeds in the first generation, indicating that the sweet type of endosperm is not common in Euchlaena.

Waxy endosperm differs from the horny in texture and in being opaque instead of translucent. It was found first in maize from China and later in maize from Burma and the Philippines. Maize varieties from other parts of the world have been scrutinized carefully for this type of endosperm, but thus far it has been found only in the three widely separated regions of Eastern Asia. The common occurrence of waxy endosperm in the Shan states of upper Burma with an extensive vocabulary of native maize names has led Collins to the conclusion that this type of endosperm originated in Burma and was distributed from there to China and thence to the Philippines.[1]

A waxy type of endosperm has been found now in several varieties of Coix (Job's tears) and also in one variety of sorghum. In appearance this type of endosperm in Coix is entirely similar to the waxy endosperm of maize, and presents the same sharp contrast with the horny endosperm as well as with the loose, or floury portion of the kernels. It may be expected that in Coix as in maize the waxy endosperm will behave as a definitely, alternative character, recessive to the horny form. From the standpoint of the origin of waxy endosperm in maize it seems suggestive that waxy endosperm in Coix is found in the same isolated regions in Eastern Asia, and as with maize, Burma seems to be the most important center.

[2] Garner, W. W., and Allard, H. A. Effect of the relative length of day and night and other factors of the environment on the growth and reproduction in plants. In Journ. Agr. Res., v. XVIII, no. 11, pp. 553-606. 1920.

[1] Collins, G. N. Waxy maize from upper Burma. Science, N.S., Vol. LII 770 1333 pp. 48-51, July 16, 1920.



VARIOUS TYPES OF JOB'S TEARS

The plant known as Job's tears (Coix lachryma-jobi), an Asiatic relative of maize, is grown not only as a source of beads, but also as a cereal. The seeds of the lower six groups shown in this photograph have the waxy type of endosperm first found in maize from China. Most of the samples which have waxy endosperm are soft-shelled, the one exception being the central group in the lower row, which is hard-shelled. The central group in the upper row is the form commonly cultivated in Europe and America as a source of beads.

Beginning at the upper left-hand corner, the sources of seed and localities from which they came will be found in the table in the following order: 34, 49, 4, 37, 43, 27, 18, 21, 11, 8, 13, 46, 33, 36, 45. The seeds are natural size. (Fig. 6.)

	Locality	*Variety*	*Source of Seed*		*Type of Shell*	*Type of Endosperm*
1	So. Shan States, Burma		S.P.I.[2]	38870	Hard	Horny
2	"		"	38871	Soft	Waxy
3	"	Ma Yuen	"	38873	"	"
4	"	Ma Yuen	"	38874	"	Horny
5	"	Stenocarpa	"	38875	Hard	"
6	"		"	38876	"	"
7	"	Ma Yuen	"	38877	Soft	"
8	"	"	"	38878	"	Waxy
9	"	"	"	38879	"	"
10	"	"	"	38872	"	Horny
11	"	Monilifer	"	38880	Hard	"
12	"	Ma-Yuen	"	44813	Soft	Waxy
13	"	"	F.H.B.[3]	28926	"	"
14	No. "	"	S.P.I.	37945	"	"
15	"	Stenocarpa	"	37946	Hard	Horny
16	"	Typica	"	38476	"	"
17	"		"	38474	"	"
18	"	Ma Yuen	"	38473	Soft	Horny
19	"	Gigantea	"	38475	Hard	"
20	"	Stenocarpa	F.H.B.	28920	"	"
21	"	"	"	28921	"	"
22	"	"	"	28922	"	"
23	"	"	"	28923	"	"
24	"	Ma Yuen	"	28924	Soft	Waxy
25	"	"	"	28925	"	Waxy-Horny
26	Mongpai, Burma	Stenocarpa	"	28878	Hard	Horny
27	"	"	"	28879	"	"
28	"	"	"	28880	"	"
29	"	Ma Yuen	"	28884	Soft	Waxy-Horny
30	"	Stenocarpa	"	28882	Hard	Horny
31	Lauksauk, Burma	Ma Yuen	"	28883	Soft	Horny
32	"	Stenocarpa	"	28881	Hard	"
33	Kachin Hills Myitkyina, Burma	Ma Yuen	"	28919	Soft	Waxy
34	Pegu, Burma	Gigantea	S.P.I.	38868	Hard	Horny
35	"	"	"	38869	"	"
36	Poona, India	Ma Yuen	F.H.B.	35933	"	Waxy-Horny
37	Saigon, Cochin-China		S.P.I.	36994	"	Horny
38	Buitenzorg, Java		"	37120	"	"
39	Singapore, Siam		"	37609	"	"
40	Mauritius		"	37227	"	"
41	Laguna, P. I.		"	47324	"	"
42	Los Baños, P. I.		*		"	"
43	Tangkulan Mindanao, P. I.	"	*		Soft	"
44	Kalasungay Mindanao, P. I.	"	*		"	"
45	Subanus, P. I. "		*		"	Waxy-Horny
46	China	"	†		"	"
47	China		S.P.I.	49345	Hard	Horny
48	Brazil		"	47617	"	"
49	U.S.A. Thorburn Seed Co.				"	"
50	U.S.A. Santa Barbara, Calif.				"	"

[2] The numbers following S.P.I. are the serial numbers of the importations made by the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. D. A.

[3] The numbers following F.H.B. are the serial numbers of the importations examined by the Federal Horticultural Board, U. S. D. A.

*Samples presented by Dr. William Weston, Jr.

†Sample presented by Dr. Yam Yei Kin.

Forty seven samples of *Coix lachryma jobi L.* from Eastern Asia have been examined, as well as three samples from the American hemisphere. These samples embrace several varieties of this species and include many of cultivated forms. The seeds vary greatly in size, shape, color, and hardness of shell, and the plants of those we have been able to grow are little less variable, some being grass-like, with numerous stalks and narrow leaves, while others with a few and thick culms and long broad leaves have more the appearance of maize or sorghum.

Although the diversity in Coix is great and it is possible to separate the seeds into widely different types, even the most extreme forms are said by Watt[4] to intergrade under cultivation. Several species of Coix have been described, but Watt accepts only two, *Coix gigantea Koen*, and *Coix lachryma-jobi-L.*, while other authorities consider all the known forms as varieties of *C. lachryma-jobi*. All cultivated forms are considered generally as varieties of C. *lachryma-jobi*, and those with a thin, loose and easily broken shell are known under the varietal name of Ma-Yuen. Practically all of the hard shell forms of *C. lachryma-jobi* are duplicated in the soft shelled series and Watt states that under continued cultivation, the hard shelled forms gradually become thin and papery. Coix has been cultivated for centuries, not only as a source of beads, but also as an important cereal in Burma, Assam, and northern India. As in maize, cross pollination is the rule, and it is not surprising, therefore, that with soft and hard shell forms growing side by side, few true breeding types are found. That interbreeding is the explanation of the change from hard to soft shells under continued cultivation is indicated by the hard shelled strain of *C. lachryma-jobi* which has been cultivated for centuries in Europe and America without losing to a noticeable degree the hardness of the shell.

The varietal names of the fifty samples examined, as well as the sources of the seed, the localities from which they came, and the type of shell and endosperm are shown in the preceding table:

Of the fifty samples, fourteen were found to contain seeds with waxy endosperm and of these eleven were from Burma, one from China, one from India, and one from the Philippines. Thirteen of the fourteen were of the soft shell type, but differed greatly in other respects. Ten of the samples from Burma contained waxy seeds only, two contained but a small percentage of horny seed, while in the samples from China, India, and the Philippines waxy and horny seeds were more nearly in equal numbers.

The discovery of waxy endosperm in Coix suggested the examination of the seeds of a Chinese sorghum received from Dr. Yam Yei Kin. This sample proved to have both waxy and horny seeds. A single panicle of *Andropogon sorghum* va. *negrosense* furnished by Dr. Weston had waxy seeds only. This sample was from Talim Island, Lak of Bay, Laguna Prov., P. I., and Dr. Weston states that the cultivation of this variety is restricted to the southern islands of the Philippines. No attempt has been made to canvass the other sorghums for this character, athough an examination of two or three of the commercial varieties showed only seeds with horny endosperm. The desirability of determining whether the waxy texture of the endosperm is confined to the Asiatic varieties of sorghum needs no emphasis, and it is important also that the wild species of Andropogonae be examined since this type of endosperm has been found thus far only in cultivated forms. Neither Tripsacum nor Euchlaena, the two American wild relatives of maize, seem to have waxy endosperm, and its occurrence in the Andropogonae and the Tripsaceae of Eastern Asia may add to other indications of the close relationship of these families.

[4] Watt, Sir George. Coix spp or Job's tears. A review of all available information. Vegetable Product Series No. 88. The Agri. Ledger No. 13, 1804, pp. 513-553.

In addition to the differences in endosperm texture the seeds of coix differ also in the color of the pericarp. The seeds of most of the hard shelled forms have a dark red pericarp while the pericarp color of many of the soft shelled seeds is a very light brown. Both red and brown pericarp colors are found in maize though by far the most common form is colorless, a form as yet not found in coix, while the only pericarp color known in Tripsacum and Euchlaena is a dark red. There is nothing to indicate whether the association in coix of the light brown pericarp with the soft shelled seeds is genetic or due simply to a discrimination against red pericarp in the cultivation of edible forms.

In maize the waxy texture of the endosperm has been found to be associated with the color of the aleurone cells of the seeds and also with a form of seed known as shrunken.[5] None of the samples examined had colored aleurone or shrunken endosperm but it is conceivable that with a larger series or by appropriate crosses these characters would be found, making it possible to compare their linkage relations in maize and coix. Even without this possibility coix should appeal to geneticists since the variability in seed and plant characters is great and the genus presents interesting morphological features.

INHERITANCE OF WEBBED TOES

Richard Schofield
University of California

IN THE family of the writer there occurs a curious type of webbed toes. The digits affected are the two nearest to the large toe on each foot, which are joined together by a webbed skin that persists as far out as the last joint. This webbing appears only in the skin and the superficial fascia, and in no way affects the bones. Sometimes the web extends a trifle beyond the last joint on the right foot, and in other cases it does not extend as far as the joint on the left foot. However this may be in any one case, it is found that the web persists always to a greater degree on the right than on the left foot. There is no noticeable inability to move either or both digits on account of the web of skin. The condition prevails at birth, not increasing as the individuals grow older.

DIAGRAM OF WEBBED TOES. (Fig. 7.)

The character always appears in the male sex, is transmitted only thru the male lineage, and it is never concealed in the males of this lineage. The daughter of an affected male may transmit the trait to her sons if this character behaved in no unusual manner, but as is shown in the accompanying chart this never occurs. Also it will be noted that it is never handed down to a daughter by an affected male.

This peculiar hereditary trait is apparently inherited as a secondary sex character. Since this condition prevails in the family of the writer, there has been ample opportunity to examine the females equally as well as the males, and all conditions noted and given here have been verified.

[5] Hutchison, C. B. Heritable Characters of Maize—VII. Shrunken Endosperm. Journal of Heredity, Vol. XII, No. 2, Feb., 1921, pp. 76-83

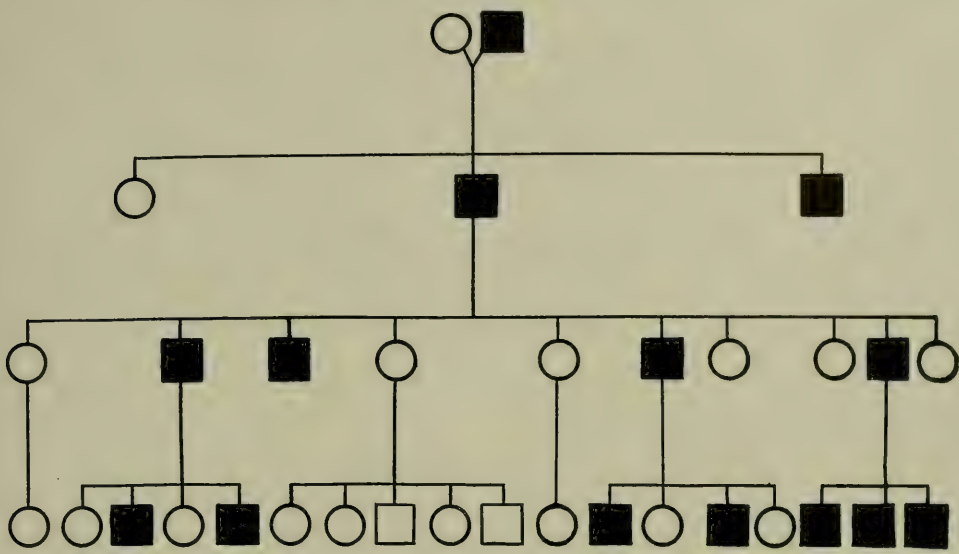


CHART SHOWING INHERITANCE OF WEBBED TOES THROUGH FOUR GENERATIONS
The webbed condition has appeared always between the second and third toes of each foot An interesting feature is that the web is always greater in the right foot. Only the male members possess the character. (Fig. 8.)

On the Wrong Track

MOTHERHOOD, by H. W. Long, M.D., neurologist and psychoanalyst. Boston, Richard G. Badger, 1921. Pp. 195.

Dr. Long writes in a frank, wholesome way, and has some sensible remarks on motherhood and preparation for it; but more than half of his book is taken up by a plea for pre-natal influence and maternal impressions as an important instrument of euthenics. He declares, erroneously, that the "gift of mentality seems to violate all known laws of heredity by its irregularities in transmission," and issues the customary cant about the unwillingness of men of science to recognize the world-old experience alleged to show the reality of pre-natal influence. I believe men of science are all ready to accept any real experience on this or any other point; but it will take a great deal more than the puerilities which Dr. Long cites, to get a hearing for maternal impressions from any intelligent adult. If his cases are the strongest that can be adduced, his cause is indeed weak. Take his case C-125 as a fair sample: Mrs. F. and her husband were habitual users of wines and liquors, but during her pregnancy Mrs. F. expressed a desire for brandy. Mr. F. economically secured a cheap and bad whiskey instead, thinking that his wife, who had never tasted brandy, would not know the difference. She took a mouthful and spit it out in disgust, saying she did not like it. "The son who came of this gestation is, and always has been, a teetotaler, and an enthusiastic temperance worker. He cannot understand how or why any one can find pleasure in strong drink." The author states that the Euthenic Society of Peoria (Ill.) is in existence to develop this line of racial betterment.—P. P.

SPECIMENS OF THE TUSCAN PEACH VARIETY WITH THE DEVELOPED LOBE MATURE

Each lobe bore its pistil and developed its own pit. Below shows one lobe of each triplet removed to show the fruit spur split so as to accommodate the lobes and permit of growth and development. (Fig. 9.)

COMPOUND FRUITS IN THE PEACH RESULTING FROM MULTIPLE PISTILS

R. E. Karper
Texas Agricultural Experiment Station, College Station

A RATHER remarkable case of multiple fruits in the peach occurred in the season of 1919 in the experimental orchard of the Texas Agricultural Experiment Substation located at Lubbock, Texas. This station is located on the Staked Plains at an elevation of 3200 feet. Peaches in this section yield well in years when they escape the spring frosts, but most varieties are usually killed in the bud about three years out of every five.

A crop of peaches was produced in 1919, which was the first full crop since 1915. The seasons of 1917 and 1918 were extremely dry and very little growth was made by the trees. In the fall of 1918 and spring of 1919 good moisture conditions prevailed, inducing a fall growth of fruiting wood, a vigorous condition of the trees and the setting of a superabundance of fruit in the spring.

SEPARATE PISTILS ON SAME FLOWER

Such abnormalities as double or two-lobed peaches resulting from compound pistils occur quite frequently; and even three lobed peaches have been observed. In this case, however, we have many simple pistils rather than a compound pistil, the multiple fruits produced running as high as quintuples and occurring in large numbers.

This phenomenon was first observed soon after the blooming period and before the corolla was shed. Each lobe of the multiple fruit in the same flower arose from a simple pistil and each lobe or member of the multiple developed its own pit. As the fruit developed one or two of the lobes or fruits would generally reach normal development, the others, becoming abortive and making very slow growth, would usually shrivel or dry up and drop, or be forced off the pedicel by the developing lobes. Many doublets and triplets developed normally and produced perfect fruit, but none above triplets developed perfectly mature fruits.

In order to accommodate the multiple fruits the pedicel was often split by the growing fruits or lobes crowded together, each lobe adhering to its portion of the pedicel.

The accompanying data show the percentage of single, double, triple, quadruple, and quintuple fruits borne from the same flower for each of the bearing trees in the orchard, and give an average for the trees of each variety.

The impressive fact of these data is that in some of the varieties the bearing of single or normal fruits is the exception rather than the rule. The interesting point in the case of multiples is that it was not a chance, or isolated occurrence, but rather a general condition existing in a large number of practically all varieties.

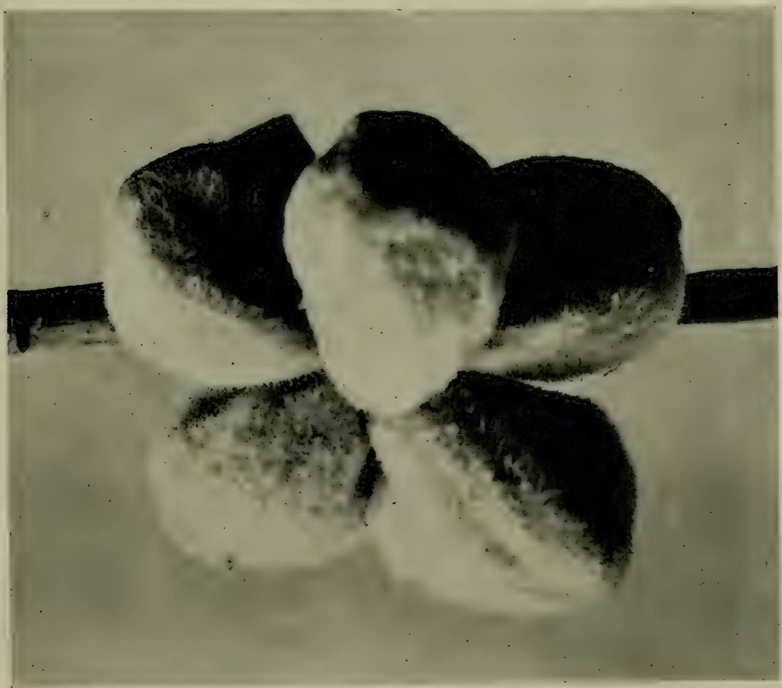
HIGH PER CENT OF MULTIPLE FRUITS

As previously stated, a full crop of peaches had not been produced by this orchard since 1915, but in 1918 the Mayflower, Salway, Alton, Krummel and Japan Blood produced a medium crop of fruit. It will be seen that this year these varieties in every instance bore comparatively few multiple fruits and that the Krummel and Japan blood bore only normal fruits. The Hottes Elberta, which bore a few specimens of fruit in 1918, had a low per cent of multiples. The seedling tree No. 121, which bore a light crop in 1918, produced forty-five per cent of the fruit in 1919 as multiples, but none above triples. With this exception none of the trees which bore the previous year produced any abnormal

Percent of Multiple Fruits Occurring in Different Varieties of Peaches

Tree No.	Variety	Percentage of Fruits				
		Single	Double	Triple	Quadruple	Quintuple
1	Mayflower*	96	4	0	0	0
2	Mayflower	87	13	0	0	0
3	Mayflower	94	6	0	0	0
4	Mayflower	89	11	0	0	0
5	Mayflower	89	11	0	0	0
	Average	91	9	0	0	0
6	Susquehanna	27	58	14	0	1
7	Susquehanna	19	61	17	3	0
8	Susquehanna	11	48	36	5	0
9	Susquehanna	14	64	20	2	0
	Average	17.75	57.75	21.75	2.5	.25
10	Hottes Elberta*	100	0	0	0	0
115	Hottes Elberta	98	2	0	0	0
117	Hottes Elberta	97	3	0	0	0
	Average	98.33	1.66	0	0	0
11	Foster*	50	41	7	2	0
12	Foster	8	81	11	0	0
13	Foster	5	81	12	2	0
14	Foster	39	60	1	0	0
153	Foster	42	55	3	0	0
	Average	28.8	63.6	6.8	.8	0
15	Tuscan*	82	18	0	0	0
17	Tuscan	3	44	40	12	1
18	Tuscan	12	42	41	4	1
154	Tuscan	25	58	16	1	0
	Average	30.5	40.5	24.25	4.25	.5
19	Orange Cling	7	44	40	9	0
20	Orange Cling	4	31	43	18	4
21	Orange Cling	2	41	44	13	0
22	Orange Cling	8	23	51	18	0
23	Orange Cling	19	31	30	17	3
	Average	8	34	41.6	15	1.4
118	Alton	75	25	0	0	0
119	Alton	96	4	0	0	0
120	Alton	91	9	0	0	0
	Average	87.33	12.66	0	0	0
124	Japan Dwarf Blood	100	0	0	0	0
125	Japan Dwarf Blood	100	0	0	0	0
126	Japan Dwarf Blood	100	0	0	0	0
24	Salway*	99	1	0	0	0
113	Captain Ede	2	68	29	1	0
114	Hiley*	92	8	0	0	0
121	Seedling	55	43	2	0	0
122	October Elberta	8	31	46	14	1
123	Krummel	100	0	0	0	0

*Trees infested with crown gall.



A TRIPLE FRUIT OF THE FOSTER VARIETY

(above)

As the fruit developed, usually one or two of the lobes would develop normally, the others being abortive and dropping or being forced off the pedicel by the developing lobes. (Fig. 10.)

A FIVE-LOBED ABNORMALITY

(below)

This five-lobed abnormality in the peach resulted from the fertilization of five pistils in the same flower and contained five pits. Normal development ceased about mid-season. (Fig. 11.)

fruits above doubles. The remainder of the trees represented in the table produced their last crop in 1915. In all of these varieties the per cent of multiple fruits is high, with Orange Cling and October Elberta the highest, having ninety-two per cent abnormalities ranging from twins to quintuples.

The trees infested with crown gall were naturally of lower vitality and in less vigorous condition, and produced quite generally a lower per cent of multiple fruits. On the other hand, the most vigorous trees and those with the heaviest set of fruit had the highest per cent of multiples.

CAUSES OF ABNORMAL PRODUCTION

In view of the data available it appears that this abnormal condition was brought about by environmental influences causing disturbance in the reproductive organs of the peach. The severe climatic conditions and lack of moisture in the soil resulted in a dormant and unproductive state on the part of the trees lasting for several years, and upon the return of favorable conditions the sudden vigor stimulated them to unusual functioning which gave rise to a tendency to overproduction. The trees have produced normal fruit in previous years, and will, undoubtedly, do so in the future unless affected by similar external influences. The proper combination of environmental factors which brought about this phenomenon may not soon occur again, yet this case proved the deep-seated influence of such factors even on the morphology of the reproductive organs in the peach.

HERITABLE CHARACTERS OF MAIZE

X. ZEBRA STRIPED LEAVES[1]

M. Demerec

N. Y. State College of Agriculture, Ithaca, N. Y.

ZEBRA striped leaves of corn were first observed in the summer of 1920 by Professor Emerson in two F_3 generation families resulting from a cross between Eight-row sweet corn and a small pop corn that had been produced by a cross of California Rice with Tom Thumb pop. The material was turned over to the writer for further study. In the summer of 1921 it was noted that among the corn grown for genetical studies some other families, distantly if at all related to the foregoing, were also segregating for zebra striping. This is an indication that the character had probably been present in the material for some time, but had not been noticed before. In the same summer apparently the same type of striping was found in the progeny from three selfed plants. The seed for one of these plants was obtained during the previous year from the Breck Seed Company of Boston. It was a yellow dent corn, Minnesota, No. 13. The seed for the two other plants was obtained from the Vermont Experiment Station. One sample was marked Freak No. 4 and the other Freak No. 5 on account of the peculiar shape of the ears. Intercrosses were made to find out if those apparently like characters were genetically identical, but these tests have not been completed.

DESCRIPTION OF ZEBRA STRIPING

Zebra striping does not show in the early seedling stage. It belongs to the group of chlorophyll characters in which the normal amount of chlorophyll diminishes with the age of the plant.

[1] Paper No. 98, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

When the seedlings are old enough, minute yellowish green dots appear as a result of the disappearance of chlorophyll. These dots are numerous and arranged close together forming regular transverse stripes. Later the dots enlarge in size and become more or less continuous yellowish streaks, the shape and size of which can be seen in Fig. 12. Zebra striped leaves are wavy probably because of unequal growth of the green and the chlorotic tissues.

Zebra striping is a distinct mature plant character. It is not very prominent in some cases, due perhaps to some modifying factor, but is always sufficiently developed so that it can be detected by careful examination. In the spring, I was able to distinguish the striping on 4-5 weeks old seedlings, but in the late fall this was not possible on still older seedlings. It is probable that a relatively strong light is necessary for the development of zebra striping.

INHERITANCE OF ZEBRA STRIPING

Zebra striping is an inherited character. Selfed zebra plants give zebra progeny only. Green plants crossed with zebra give in the F_1 generation green plants only. Plants heterozygous for zebra crossed with homozygous zebra gave 178 green and 152 zebra plants, which is fairly close to a 1:1 ratio. From this it might be concluded that zebra is a simple mendelian recessive. The data obtained from the F_2 generation, however, show in some cases a very low percentage of zebra plants. Six F_2 families had a total of 115 green and 20 zebra striped plants. Four of these families, however, had 92 green and seven zebra plants, which is very nearly a 15:1 ratio. One family, on the contrary, had only 17 green to 11 zebra striped plants. Some of Professor Hutchison's pedigrees also, which are not closely if at all related to the material used in this study, segregated for zebra striping. He found 307 green and 107 zebra plants, practically in 3:1 ratio. At this time the genetical tests are not complete enough for final factorial analysis. The only conclusion that can be drawn is that zebra striping is a mendelian character and that it is recessive to green.

ZEBRA STRIPED LEAF

Transverse stripes made up of numerous yellowish dots appear on the leaves of corn in the young plant stage and become more pronounced in later stages of development by the enlargement and coalescence of these dots. (Fig. 12.)

EXPERIMENTAL GIGAN

E. UHLENHUTH, *Rockefeller Insti*

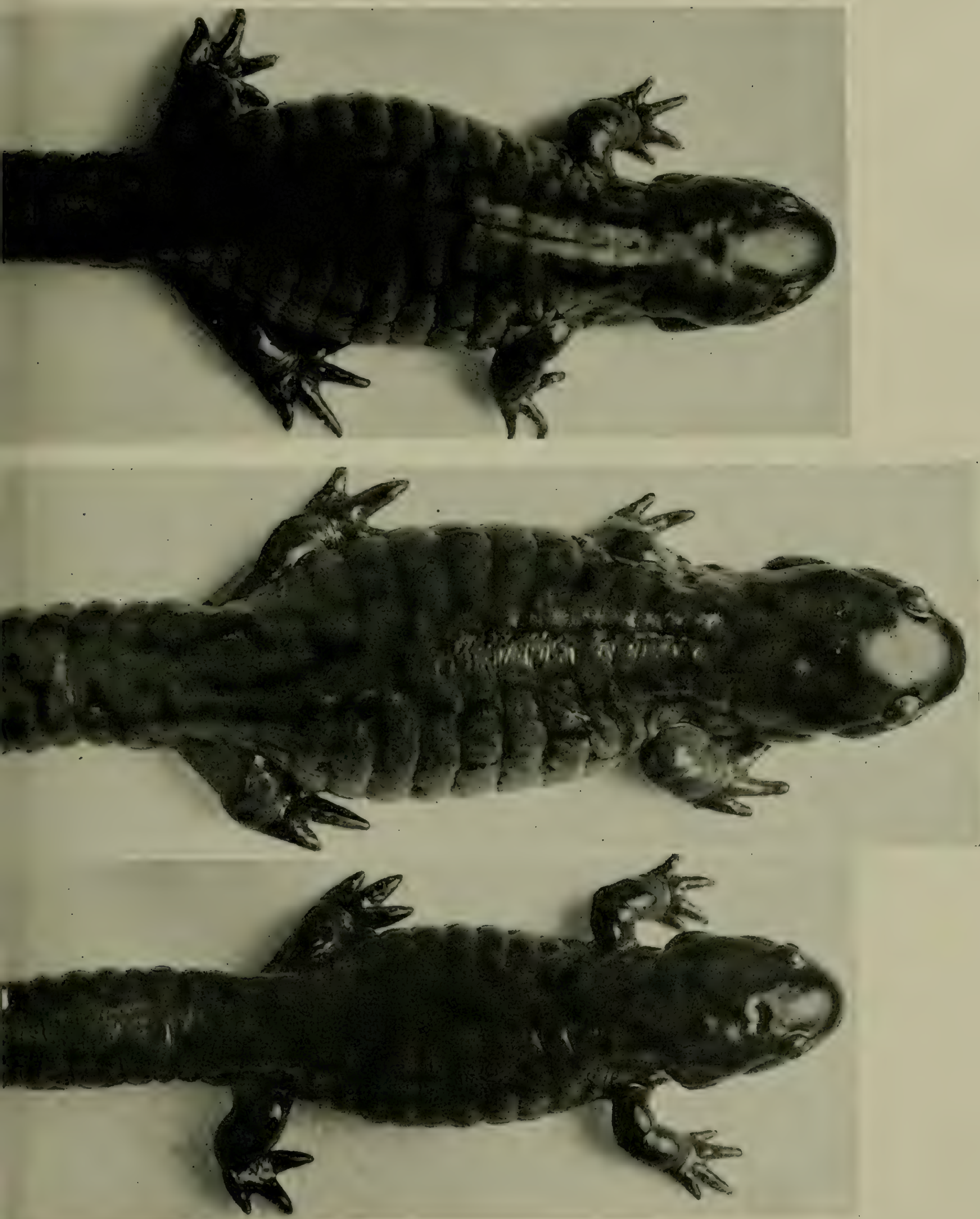
Natural size photographs of salamanders showing effect of diet upon growth. The top animal was fed beef liver, the middle one anterior lobe and the bottom one earthworms.

Although certain facts, such as the considerable enlargement of the anterior lobe of the hypophysis in human gigantism and in acromegaly, have made it almost certain that the pituitary body plays some important rôle in the phenomena of overgrowth and in growth in general, it has not been possible to produce gigantism in animals by feeding anterior lobe. So far, in the experiments of feeding pituitary only warm-blooded animals have been employed. If, however, anterior lobe of the hypophysis is fed to the cold-blooded salamander, *Ambystoma tigrinum*, a considerable overgrowth is secured.

This fact is illustrated by the accompanying figure, which shows three male salamanders of the same brood and age, taken from a large number of feeding experiments performed on this species of animals during the last three years and giving essentially the same results. A different food material was fed to each of these three animals, each one representing the largest individual of a group of similarly fed animals. The middle animal was fed anterior lobe of hypophysis, the bottom one a normal diet (earthworms) and the top one beef liver. It will be seen at the first glance that the anterior lobe-fed animal is, by far, the largest one; its

ISM IN SALAMANDERS

r Medical Research, New York City



weight exceeds by 96 per cent that of the normal worm-fed control animal. The liver-fed animal is larger than the control animal, but much smaller than the anterior lobe-fed animal.

Although liver-fed animals grow larger than worm-fed animals, neither liver nor earthworms permit the salamanders to become as large as the hypophysis-fed animals. It is noteworthy that the hypophysis-fed animals exceed in size not only the controls, but are considerably larger than any known normal individual of that species. (Fig. 13.)

MENDELISM IN FUR SHEEP CROSSES

Russell W. Duck
Department of Animal Husbandry, Syracuse University

SOME interesting results have been obtained from crossing Karakul rams on long-wool and Cheviot ewes. Work along this line by F. E. Dawley, of Fayetteville, N. Y., shows the complete dominance of Karakul fleece, provided the Karakul cross is homozygous, for the color and fur bearing factor. The work also shows the practical value of a knowledge of Mendel's first law.

Karakul lambs at birth are black in color with an occasional white spot on the head or tail, the ringlets of fur should be of a bright luster and tight curl. Density, curl, luster, pattern and color are the factors which determine merit in a Karakul skin, known commercially as Persian Lamb. The beauty of pattern formed by the irregular arrangement of the curls, and the fineness and softness of the coat add much to its value. The desired condition of the skin of the lamb soon disappears as it grows older. When only twenty-four to forty-eight hours old the curls begin to loosen, and the fleece increases in length; as the lamb nears six months of age the fleece gradually changes to dark gray wool, very long and open in character.

Davenport found black wool recessive to white in sheep. He has shown that black crossed on black gives only black, and that black outcropping in white sheep is simple recessive segregation. But, in the Karakul cross on white wool, the white wool factor behaves quite differently, it is unmistakably recessive to black.

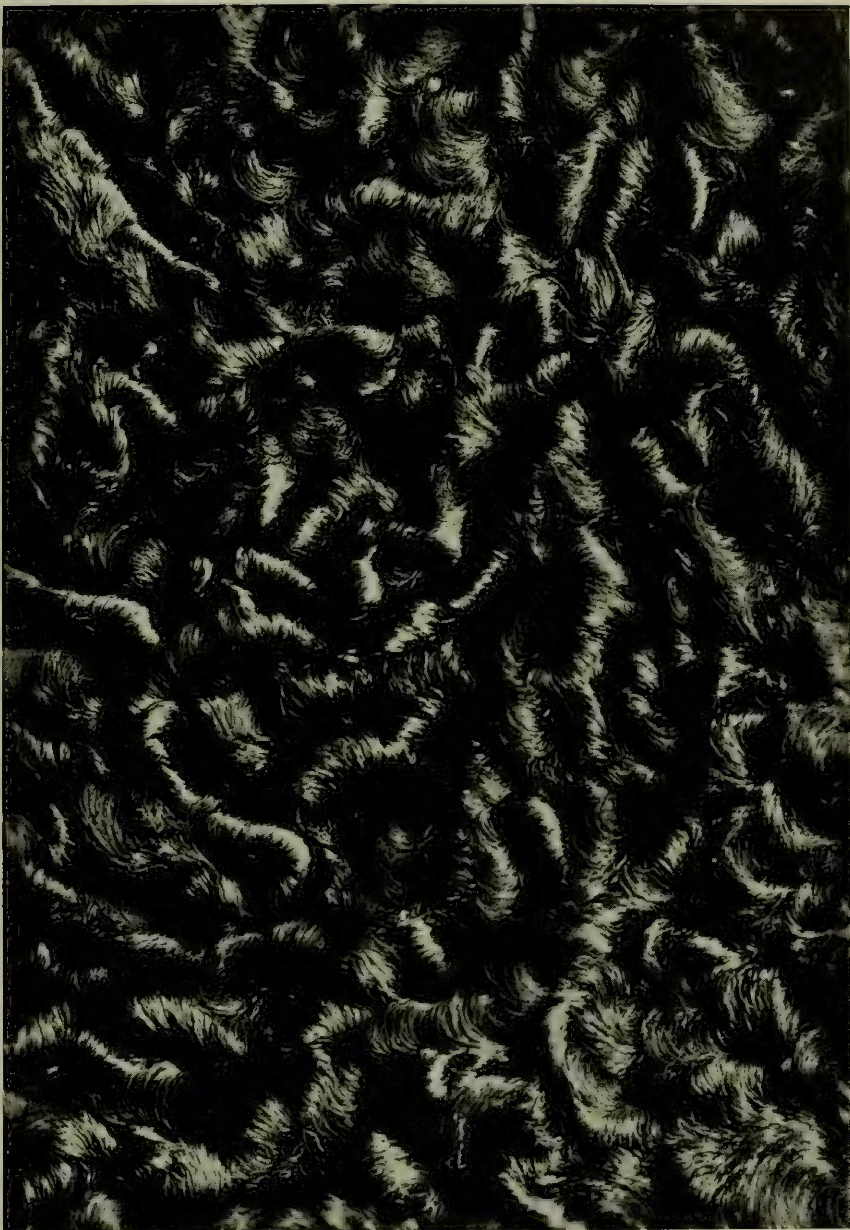
In 1912 Mr. Dawley made some crosses to determine the inheritance of coat color and fur bearing qualities of Karakuls when crossed on other breeds. Two large type Karakul rams, forty Lincoln, twenty Leicester, twelve Cheviot, ten Black Faced Highland and ten Cotswold ewes were used in the first cross. The same ewes were bred to the same rams again in 1913. The table at the bottom of this page shows the results obtained.

Out of ninety-two ewes and two years' lamb crop all the lambs except two were black. One red lamb was dropped in 1912 by a Leicester ewe and another was yeaned in 1913 by a Lincoln ewe. The production of an occasional red is apparently not associated with any particular breed, and might be explained by the introduction of an extension factor, which is of infrequent occurrence. The dominance of black color was duplicated by three other characters, curl, density and luster, which proved dominant to straight, long, dull wool. The skins of the F_1 lambs were decidedly of the fur type. From the illustration it will be noted that the skin from an F_1 lamb was curled and lustrous, closely approaching the desired Karakul type (Persian Lamb).

In 1914 and 1915 the F_1, black ewes from the first cross were bred back to an imported Karakul ram

Karakul Rams Crossed with Other Breeds.

Parent				Offspring			
Sire	No.	Ewes	No.	1912		1913	
				Black	Not Black	Black	Not Black
Karakul	2	Lincoln	40	42	None	45	1 red
"	2	Leicester	20	22	1 red	23	None
"	2	Cheviot	12	18	None	16	None
"	2	Bl. Faced Hi.	10	12	None	14	None
"	2	Cotswold	10	12	None	13	None



SKIN FROM FIRST GENERATION CROSS—KARAKUL RAM BY LIN COLN EWE

Experiments in crossing Karakul rams on long-wool and Cheviot ewes have brought some interesting results in color and fur bearing factors. The Karakul skin is characterized by dense, lustrous ringlets of fur, the density and luster becoming less as the animal grows older. The skin shown in the photograph is from a first generation crossbred between a homozygous Karakul ram and a registered Lincoln ewe. It shows the dominance of black color, and also proved that the other characters of curl, density, and luster were dominant to straight, long, dull wool. (Fig. 14.)

IMPORTED ABOU BEN ADAM HOMOZYGOUS RAM

This ram, eleven years old at time of photograph, was used to produce the first generation cross in the experiments to determine the inheritance of coat color and fur bearing qualities of Karakul sheep when crossed with other breeds. "Out of ninety-two ewes and two years' lamb crop all the lambs except two were black." (Fig. 15.)

named Pultava. The table on page 413 shows the results obtained from this back cross.

The ewe lambs yeaned in 1913 were not bred back until 1915 so that more individuals were used in the 1915 back cross than in 1914. The results show an apparent contradiction to the first cross; however, such is not really the case. With our present knowledge of Mendelism, these characters are ap-apparently simple allelomorphs, and therefore prove that the Pultava ram was heterozygous (mixed) for both the color and fur factors. His blood has since been discarded in the Dawley flock. The selection and breeding of fur sheep in their native country is not always done as carefully as the American breeder could desire. Outcrosses have, no doubt, been used which would result in a heterozygous individual for both the color and fur factor. Flock books are not maintained and records are imperfectly kept at best. This accounts for the apparent contradiction in the second cross. The results of later crossing proved this conclusion of the mixed character of the Pultava ram.

In 1916, '17, '18, and '19 black ewes were selected which showed desirable curl, density and luster, they were mated to Karakul rams of supposed

pure strain. Any ram that threw off-colored or off-type lambs was discarded. In the 1920 cross all the lambs thus produced were black in color and the fur, without exception, could not be distinguished from that produced by imported Karakul ewes or their off-spring.

Therefore, so long as the breeder is dealing only with allelomorphic characters which follow Mendel's first law of dominance, recessiveness and segregation it is quite easy with a knowledge of these basic principles to produce maximum results in minimum time.

In a later article the Mendelian principles underlying the appearance of an occasional red lamb will be offered.

Heterozygous Karakul Ewe Lambs Crossed on "Supposed" Homozygous Karakul Sire

Parent		Offspring					
Sire	Ewes	No.	Black	Spotted	Red	White	Year
Pultava	F. 1	56	41	6	5	11	1914
"	F. 1	100	80	9	8	14	1915
Total		156	121	15	13	25	
Expected		156	172	None	1 or 2	None	

Evolution and Social Progress, by Joseph Husslein, S.J., Ph.D. Pp. 287. New York, P. J. Kenedy & Sons, 1920.

Dr. Husslein vehemently assails "materialistic evolution," which he says is the doctrine commonly taught, and which he believes to imply atheism, and to be subversive of morality. He accepts "scientific evolution," which he says is all of the evolutionary doctrine that is supported by actual facts, as distinguished from the speculations and hypotheses that pass for facts with the materialistic philosophers. The doctrine of evolution as thus qualified seems to include (1) belief in the existence of God as Creator; (2) acceptance of the evolution of the inorganic world along the lines of the nebular hypothesis; (3) belief in the creation of an indefinite number of low types of plants and animals, with evolution of other forms from these original creations; (4) adherence to the idea that man was specially created, perhaps not more than 10,000 years ago, and is not a descendant of a lower or more generalized type of animal; (5) supposition that religion, morality, social organization, etc., are the products of Divine revelation rather than of evolution as generally understood. Several chapters are devoted to an attempt to show that the first chapter of Genesis, properly interpreted, is in accord with the best modern scientific knowledge: "either Moses knew as much about science as we, or else he was inspired." It is difficult to review adequately, in a scientific journal, a volume which is written from a point of view so radically different from that of the world of science. Dr. Husslein's book takes one back to the period of Haeckel, Huxley, Bishop Wilberforce and the Duke of Argyll; but it marks some advance, at least, in the attitude of the extreme exponents of dogmatic theology. The author makes the most of the inconsistencies and differences of opinion of the biological world, but he is not likely to be convincing except to those who want confirmation of their existing convictions.—P. P.

Former Numbers of the Journal Wanted

The office of the Journal desires copies of some previous issues of this Journal as its supply is exhausted. If any member will dispose of the following, please communicate with the managing editor: January, February, March, and April 1914; October 1918; January, February, and April 1920.

INFLUENCE OF THE THYROID GLAND AND HYPOPHYSIS UPON GROWTH AND DIFFERENTIATION

Bennett M. Allen
Department of Zoology, University of Kansas

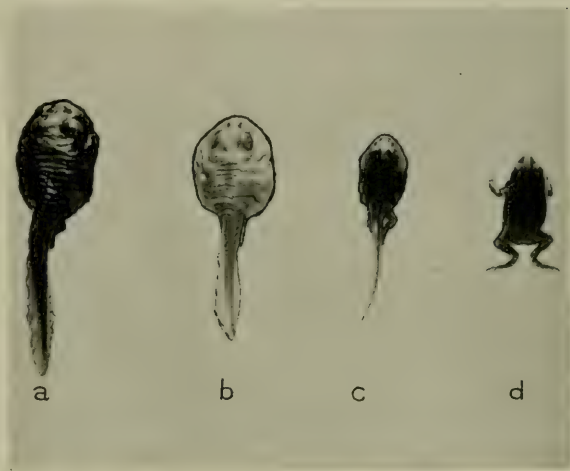
RECENT years have witnessed spectacular advances in our knowledge of the endocrine or ductless glands. This field was a terra incognita thirty years or more ago, but today it is a field of enchanting possibilities. The thyroid gland and the hypophysis, with which this paper deals, exert a profound influence upon growth and differentiation, not only among the amphibians upon which our experiments have been performed, but likewise in man as we are learning from a study of dwarfs and giants.

While clinical evidence is of very great importance in bringing us close to the practical problems of medicine, we are here dealing with the influence that these glands exert as a result of disease, and we must constantly keep in mind the fact that the conditions observed are pathological, that the endocrine glands are in these cases functioning in abnormal ways. With experiments upon mammals we meet the difficulty that these glands can be removed only after birth, while as a matter of fact, the embryo undergoes the most important part of its development before birth. Definite direction is already given to some of the most important features of growth and differentiation of mammals long before we can hope to operate upon them. We have no intention of belittling the very significant pioneer work, such as Hoffmeister and others, practiced in the removal of the thyroid glands of dogs and sheep. Such work has its great value but it does not give a wholly pure result. We are not in these cases dealing with animals that never have been under the influence of these glands. While these various methods of experimentation have their value, we can get a "chemically pure" reaction only when we may remove these glands at their inception when we extirpate their anlagen. By far the most favorable opportunity for work of this kind is afforded by experiments upon amphibian larvae, which develop from eggs fertilized outside the body of the parent. The tadpoles are peculiarly resistant to the most severe operations, showing a marvellous capacity for healing wounds and there is an unusual degree of resistance to infection. The process of differentiation is marked by the spectacular metamorphosis of the tadpole into the frog. These favorable features make it possible for us to remove these glands with success and to observe the effects most clearly.

We may also attack these problems from a different angle—by adding these glandular secretions instead of eliminating them. This may be done in three ways: (1) by feeding, (2) by hypodermic injection, and (3) by implantation. By a combination of processes of gland removal and addition of extracts and living tissue, we may at will create in our tadpoles almost any desired combination of endocrine glands. We may remove and reinstate at pleasure. The thyroid gland was fed to tadpoles by Gudernatsch in his pioneer investigations. This experiment many times repeated by others results in precocious metamorphosis—a process that affects the organism as a whole, not only involving the development of the limbs, tongue, mouth, brain, and other internal structures, but bringing about the shortening of the intestine and disappearance of the tail as well.

A complete reciprocal of this experiment is found in the removal of the thyroid gland. This experiment was performed simultaneously by Allen and

Hoskins. The results are most interesting. Development proceeds quite normally for two months or more, up to the time of appearance of the hind limbs. In every regard, both of size-growth and differentiation, the thyroidless specimens resemble the normal controls up to this period. In normal tadpoles there is before this time no accumulation of colloid secretion in the thyroid gland. This period—the beginning of metamorphosis—is the stage at which the thyroid glands begin to differentiate and to actively function. In normal development metamorphosis follows as a direct result of this development and functional activity of the thyroid gland, while in the specimens from which this gland has been removed there is an almost complete cessation of metamorphosis. The tadpoles grow to gigantic size and they have been reared to an age of three years but the hind limbs remain very small and in no case of complete thyroid removal do the fore limbs break through the skin. It is a significant fact that the tadpoles of the common toad Bufo lentiginosus reach a more advanced stage of development when deprived of the thyroid gland than do the tadpoles of the leopard frog Rana pipiens. It seems clear that various other factors carry development up to a certain point beyond which it can not proceed under normal conditions without the functioning of the thyroid gland. The degree to which thyroidless tadpoles may develop differs in different amphibians.



BUFO (TOAD) TADPOLES AND RECENTLY METAMORPHOSED TOAD. NATURAL SIZE

(a) A thyroidless tadpole six months after normal time of metamorphosis. (b) A pituitaryless tadpole six months after normal time of metamorphosis. (c) A normal tadpole in limb development of corresponding degree to that in a and b. (d) A normal toad immediately after metamorphosis. (Fig. 16.)

A careful study of these tadpoles thus retarded in development shows that, so far as we can see, the retardation affects not only the superficial features of limb-growth and tail-shrinkage, but that it also applies to all of the internal structures as pro-nephros, pancreas, liver, alimentary tract, thymus gland and even the process of ossification. The brain not only appears to retain its larval condition when viewed externally; but microscopic sections demonstrate this fact most clearly. This is especially suggestive in view of the well known fact that cretins are so often sub-normal mentally. All of these features seem chained in their embryonic conditions. In striking contrast to these somatic features we find that the germ glands and germ cells continue in their development. Not only do they grow in size, but they continue to differentiate, ripe sperm developing in the testis of Rana pipiens larvae prevented from metamorphosing by thyroid removal. This is evident some four or five months after the time of normal metamorphosis. In the normal controls spermatogenesis does not occur until about this length of time after metamorphosis. While oocytes have not become mature in these thyroidless tadpoles, they have at least undergone increase in size far beyond that reached at the time of normal metamorphosis. It thus seems clear that there is a radical difference between the somatic structures and the germ glands. The

development of the former is controlled by the thyroid gland while the gonads develop independently of it. We should not at this time lay too great emphasis upon this point, but it is at least suggestive. If substantiated by further investigations, such a radical difference between soma and germ cells would be most significant in view of the theories of heredity that are based upon the assumption that the germ-cells are not influenced by changes in the soma.

It has been long known that iodine is the most characteristic chemical constituent of the thyroid secretion; it is therefore interesting to find that by feeding iodine, Swingle produced the same effects of metamorphosis in tadpoles that are produced by feeding thyroid preparations. We are thus led to the conclusion that the iodine accumulated by the thyroid gland is the active agent in the acceleration development. Kendall's interesting work in the analysis of the thyroid secretion should be taken into account. He has isolated the substance thyroxin, the constituent richest in iodine and considers this compound to be the active agent involved. It remains to be seen whether the simple iodine element alone can accelerate development in forms other than the amphibians. There is no question about its potency in that group. Swingle was even able to show that tadpoles deprived of the thyroid gland can be made to transform when fed iodine.

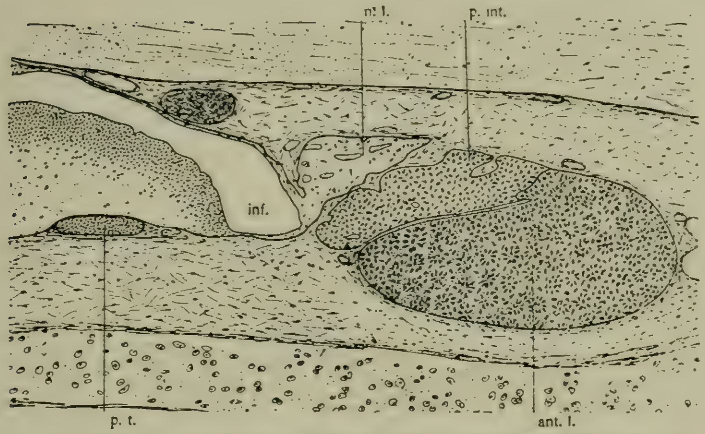
THYROID FEEDING CAUSES SHRINKAGE

While the thyroid gland has a marked influence upon the process of differentiation, it appears to regulate size growth secondarily through its influence upon the attainment of maturity. Feeding or implantation of the thyroid gland brings about a distinct shrinkage of tadpoles so treated. This has been by some described as a "burning up" process due to greatly accelerated metabolism. This might prove true but we should be cautious and demand proof upon this point. It is well known that the tissues of amphibians, especially in the larval stage contain an enormous percentage of water. Only careful weighing of dried specimens can serve to determine whether thyroid or iodine feeding does or does not cause an actual wasting of the essential substance. Students in this laboratory are now working upon this question and upon the relation of the thyroid glands to the fat bodies—a nearly allied problem. Certain it is that thyroid feeding causes shrinkage rather than size growth.

THE HYPOPHYSIS

The hypophysis, often called the pituitary gland, is really made up of four parts physiologically quite different from one another, at least this is true of the three portions whose functions we are beginning to understand. Three of the four portions arise from a cord of cells that grows inward from the surface layer of the body and comes to lie under the brain. It develops into anterior lobe, intermediate lobe and lateral lobes (pars tuberalis). A fourth portion develops from the tip of the infundibulum of the brain with which the hypophysis comes in contact. These portions are shown in the figure. It is possible to remove the entire cord of cells from which all but the posterior lobe develop. The latter develops in the absence of these portions; but Smith claims that it does not attain normal growth.

With the removal of the anlage of these lobes (anterior, intermediate, and pars tuberalis portions) certain striking effects are produced, as follows: (1) Prevention of metamorphosis at the same stage attained in the absence of the thyroid gland. (2) Retardation of growth in size. (3) A most striking color change from the normal black to white, due to the contraction of black pigment cells and an expansion of certain silvery white cells, the xantholeucophores. (4) Apparently heightened mortality evident only several weeks after the operation. This was first accomplished by Adler by rather imperfect technique. Later Allen and Smith independently devised a much better operation for removal. The writer has made a partial analysis of these functions by implanting separately the anterior lobe,



A SAGITTAL SECTION OF THE HYPOPHYSIS (PITUITARY GLAND) OF THE FROG

Ant. l—Anterior lobe. p. int.—Intermediate lobe. n.l.—Posterior lobe (neural lobe). p.t.—Lateral lobe (pars tuberalis). (Fig. 17.) Illustration from *The Anatomical Record* Vol. XV, No. 2, Sept. 1918.

the intermediate lobe and the posterior into specimens from which the three lobes mentioned were extirpated. These tissues thus transplanted were taken from adult frogs and transferred to a pocket under the skin above one eye of the tadpole at some distance from the normal position. The results are most striking. The transplantation of the anterior lobe brings about an initial increase in size and a strong tendency toward metamorphosis. Complete transformation has not been produced in this manner but there has been a close approach toward it. This lobe has no influence upon the color change, but the restoration of the intermediate lobe into the white pituitaryless specimens causes a resumption of the normal black color. The influence of the anterior lobe of the hypophysis upon metamorphosis—growing mature—is closely linked with the thyroid gland. In tadpoles from which the hypophysis has been removed, the thyroid gland is very poorly developed. A few follicles are formed with very small masses of colloid secretion. Evidently the thyroid gland remains inactive in the absence of the anterior lobe of the hypophysis, the two being most intimately associated in physiological activity. It was stated above that the transplantation of the anterior lobe of a frog hypophysis into one of these tadpoles deprived of its hypophysis causes a resumption of development. It is most significant that this accompanies a marked increase in the size of the thyroid gland and of its contained colloid secretion. The restoration of the anterior lobe of the hypophysis thus causes a resumption of the growth and functional activity of the thyroid, and the tadpole proceeds on its way toward metamorphosis.

Smith has shown that feeding the anterior lobe of beef hypophysis to tadpoles of Rana boyeli from which the hypophysis had been removed, causes them to resume their normal rate of size growth that had been inhibited by its absence. Hoskins claimed that the feeding of commercial hypophysis preparations also produces metamorphosis, but Smith has shown that this is not the case where he himself secured and prepared his material. Hoskins had analyzed the commercial preparation that he used and demonstrated a small quantity of iodine which he considered too little to produce an effect. The presence of this iodine was probably due to contamination and the amount was, contrary to Hoskins' judgment, sufficient to produce the metamorphosis that he observed. The writer also produced partial transformation with commercial preparations in unpublished experiments performed five years ago, but hesitated to publish the result because of doubt regarding the purity of the preparation. We are thus forced to conclude that the feeding of laboratory prepared anterior lobe of the hypophysis, free from iodine or possible thyroid contamination, does not bring

about metamorphosis, although it does produce growth in size.

There is a most important difference between the influence of the active implanted anterior lobe of the hypophysis on the one hand and on the other the effects of feeding this gland. In the case of implantation, metamorphosis is furthered through the co-operation or intermediation of the thyroid gland. This is evidenced by the effect of such implantation upon the thyroid gland as explained above, and by experiments performed by the writer in which it was shown that implantation of the anterior lobe of the hypophysis of an adult frog into tadpoles from which the thyroid gland has been removed does not produce any tendency to metamorphosis even though the implant is preserved in normal condition. On the other hand its implantation into normal tadpoles hastens their metamorphosis and its implantation into specimens from which the hypophysis has been removed brings about their transformation, this being always accompanied by increase in the size of the thyroid gland. Keeping these facts in mind and remembering that extirpation of the anterior lobe of the hypophysis prevents metamorphosis, allowing development to proceed only to the point attained in thyroidless tadpoles, we may conclude that there is an intimate functional correlation between these glands and that their co-operation is essential to metamorphosis, unless abnormal amounts of iodine are administered.

A sharp distinction must be made on the one hand between development toward maturity regulated by the functional co-operation of the thyroid gland and the anterior lobe of the hypophysis, and on the other hand the very distinct feature of size growth. This size growth appears to be accelerated by the action of the anterior lobe of the hypophysis alone and is produced by substances-hormones stored up in the gland and active even in dried preparations.

In this connection it is most significant that feeding of dried thyroid glands to tadpoles causes metamorphosis, not only in normal and thyroidless tadpoles, but also in tadpoles deprived of the hypophysis and also in those deprived both of hypophysis and thyroid gland. There is evidence to show that such thyroid feeding does not operate so rapidly toward bringing about a shrinkage of the tail in tadpoles deprived of the hypophysis as it does in those that retain it in a functional condition; but this demands more accurate analysis.

It was pointed out above that Swingle accelerated metamorphosis in normal tadpoles by feeding iodine and that he produced it even in tadpoles deprived of the thyroid gland. Allen showed that iodine feeding would produce metamorphosis in tadpoles from which the hypophysis had been removed and also in those from which both hypophysis and thyroid gland had been removed.

We may from these facts conclude that the process of metamorphosis (growing mature) or these anuran larvae can only take place under normal conditions in nature by the co-operation of the thyroid gland and the anterior lobe of the hypophysis, and that the hormone thus formed is stored in the thyroid gland. It is certain that the most active chemical element in this hormone is iodine and it is probable that the colloid secretion that contains this hormone is in the main active in proportion to the amount of iodine that it contains. We can not say more at present. The functioning of these glands enables vertebrates to segregate the minute traces of iodine that occur in their food and water and to utilize it in furthering development (metamorphosis in the amphibians). In the absence of either or both of these glands it is necessary to administer relatively enormous quantities of iodine in order to accomplish the results normally attained through their agency with the scarcely demonstrable traces of iodine as it occurs in nature.

A BASIS FOR INTERPRETING HUMAN PROBLEMS

These experiments upon amphibian

larvae appear to show that the thyroid gland and hypophysis act in a broad general way upon growth and differentiation of the soma rather than in specific fashion upon certain parts. Studies upon these growth processes in amphibians have an interest to us because of their bearing upon human problems; they furnish a basis for a proper interpretation of important pathological conditions in man. While the study of clinical data has its important medical interest, we must expect to find that the conditions produced by disease of these glands are much harder to analyze than are the results reached by experimentation.

ABNORMAL DEVELOPMENT—OR GIGANTISM

We are familiar with the explanations usually offered to account for gigantism. Marie pointed out in 1886 that this condition of abnormal height is usually the result of enlargement of the hypophysis (pituitary gland) during early life. Frequently this enlargement is due to tumor formation often the result of fracture of the skull in the pituitary region. This early increase in size at first leads to heightened function, but as the disease progresses it usually brings about an under production of secretion leading to lethargy and early death. This disease of the pituitary gland produces abnormal growth of the nose, lower jaw and feet, and it causes the fingers to assume a peculiar spatulate form and to undergo a certain degree of pigmentation. If this enlargement of the pituitary gland takes place after the attainment of maturity, the extreme growth in height can not result because the cartilage plates joining the ends of the bones to the main central portion have been ossified. This late development of these symptoms without giant growth is termed acromegaly. It has been pretty well demonstrated that these conditions result from abnormal development of the anterior lobe of the hypophysis (pituitary gland). And the sharply defined experiments upon tadpoles as outlined above give very definite support to this view.

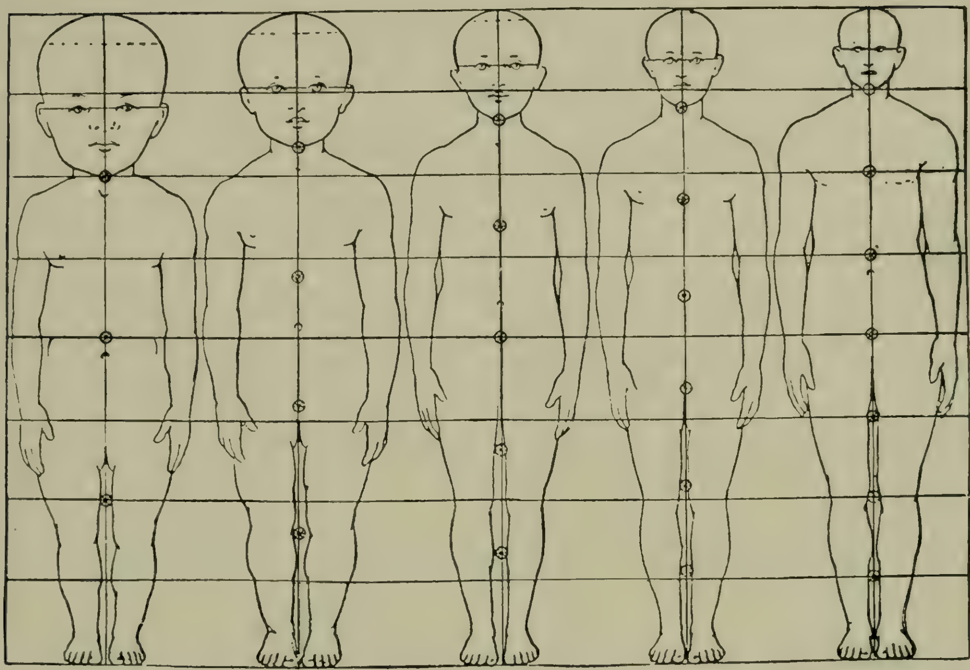
UNDER DEVELOPMENT—OR DWARFISM

A certain type of dwarfism in which the bodily proportions remain infantile but where the mentality is normal or nearly so, is termed ateliosis. Cushing and others have attributed this condition to an under development of the anterior lobe of the hypophysis. In these cases the ends of the bones remain separated from the main body of the bone by plates of cartilage long after the time when they should normally unite with it; but in spite of this there is a peculiar inhibition of growth and the bones all remain both short and slender. We have not as clear evidence that under development of the anterior lobe of the hypophysis produces dwarfism as we have regarding the influence of its over development in the production of gigantism.

The thyroid gland is definitely involved in another type of dwarfism termed cretinism. These cases are common in certain goitrous regions, especially among the southern Alps, and are often accompanied by that disease. It frequently entails idiocy. This condition results from thyroid insufficiency during childhood, and is the direct outcome of a failure of the ossification process in the cartilage plates near the ends of the bones. The latter fail to grow in length but may increase considerably in thickness. While cretinism differs from ateliosis in the fact that the body is more plump, the mentality low and the skin coarse and puffy and there is a general lowering of metabolism, yet there is a significant similarity between them in the retardation of the process of ossification. This is in line with the work of Mr. Terry done in this laboratory, in which he showed that a similar inhibition of ossification is produced in tadpoles as a result of removal of the thyroid gland. These skeletal features constitute merely a phase in the general infantile conditions. In ateliosis there is simply a failure to become physically mature, probably due to

A GROUP OF DWARFS CHIEFLY ILLUSTRATING ATELIOSIS

Ateliosis is the term used to describe "a certain type of dwarfism in which the bodily proportions remain infantile but where the mentality is normal or nearly so." Most of the dwarfs in the picture are of that type. Three—possibly four—illustrate achondroplasia (very large head and extremely short limbs); and one at least appears to illustrate myxoedema (coarseness of features). Note the text on the preceding and following pages for more complete statements of these conditions. In addition to experiments upon amphibians, it is being learned from a study of dwarfs and giants that the thyroid gland and the hypophysis (pituitary gland) "exert a profound influence upon growth and differentiation." Photograph from C. B. Davenport (in Genetics, Vol. 2). (Fig. 18.)



DIAGRAMS TO SHOW HUMAN BODILY PROPORTIONS AT DIFFERENT STAGES OF DEVELOPMENT FROM INFANCY TO MATURITY

Illustration from C. B. Davenport (in Genetics Vol. 2, page 350). (Fig 19.)

the under functioning of the hypophysis. This probably produces an under functioning of the thyroid gland to which the retardation in development would appear to be more directly due. Nevertheless the thyroid gland would seem in these conditions to function sufficiently to prevent the appearance of myxoedema seen in the cretin. In the latter cases the thyroid gland has been deeply diseased in childhood, not only involving a retardation in the development of the structural features and bodily proportions of maturity, but resulting in features of myxoedema as outlined above. The infantile proportions seen in ateliosis and cretinism involve a relative shortness of the limbs. This is quite in line with the very slight development of the limbs of tadpoles deprived of the thyroid gland, the pituitary gland or of both. It is needless to say that here in the tadpole we are also dealing with the maintenance of infantile tadpole characteristics. The similarity between these features in man and in the tadpole is more than a mere coincidence, it is in each case due to a retardation in bodily development.

These statements are made with the full recognition that they are partly based upon debatable data, but in the hope that they may lead to more accurate observations along these lines.

Achondroplasic dwarfs constitute a class quite different from the above. In them the trunk is little below normal size but the head is usually very large and the limbs extremely short. This differs from cretinism chiefly in the fact that there are no evidences of myxoedema and in the large size of the head, accompanied by hydrocephalus. The shortness of the limbs is also more marked than in cretinism, and intelligence is more nearly normal, often quite so. This condition manifests itself very early, usually in foetal life as shown in the difficulty of labor at birth. The cause of the condition is very obscure but may well be due to some abnormality of the thyroid or pituitary glands of either the foetus or

the mother. Careful observations along these lines are much to be desired. It has been shown that dwarfism in its various forms tends to be congenital, as shown in Rischbieth and Barrington "Treasury of Inheritance."

CONCLUSIONS

The last quarter century has witnessed a most brilliant series of discoveries in cytology and heredity. We talk a jargon in which are heard such terms as Mendelism, allelomorphs, genes, sex-determination, sex-linkage, crossing-over, etc. We have built up an edifice of theory that is amazing and a bit bewildering to one who can not lay claim to being a specialist. Out of it comes one insistent impression, namely, that our fate is sealed at the time of union of egg and sperm—that our future is decreed in the chromosomes. It is no doubt true that the nuclei of the germ cells carry definite tendencies that interact upon one another to shape and direct development.

On the other hand it is equally true that other factors are at work shaping the course of development. Most prominent among these are the endocrine glands. The writer freely admits that the character and functional activity of these glands may be in large part determined by hereditary tendencies, yet disease and accident play at times a very important rôle. It has been clearly shown that development toward maturity in the tadpole of the leopard frog will proceed only to a certain point in the absence of the thyroid gland or of the anterior lobe of the pituitary gland. Having reached this point the process ceases. In the common toad this process of growth toward maturity continues to a somewhat later stage than in the frog and there ceases just as abruptly. Beyond these points there may be very slight further progress but it is practically negligible. It is interesting to note that:

1. The stage reached is a definite one peculiar to the species. Development up to this point is quite normal, leaving out of account a slight retardation in size growth in the absence of the pituitary gland.

2. This stage is reached equally in the absence of the thyroid gland, of the anterior lobe of the pituitary gland or of both, and further development is possible only in the case of

(a) transplantation of the missing gland or glands or

(b) feeding with thyroid gland material or

(c) feeding with large quantities of iodine.

Now the practical value of these discoveries lies in the fact that they show us ways not only of correcting certain types of abnormal size growth and development; but give us hope that we may some day modify what we consider to be normal growth and development. This may at some future time be carried out in a thoroughly practical way. While we can readily cause half grown tadpoles to quickly develop into little weazened frogs by feeding them thyroid preparations or iodine, it still remains to be seen how far we may stimulate them to size growth beyond the normal limits of the species by any process of administration of the anterior lobe of the pituitary gland. Uhlenhuth has shown that feeding pituitary preparations to Ambystoma causes giant growth in size. This fits in with our theories regarding the causation of gigantism.

We may be permitted the hope that through our knowledge of these glands we may be able to largely control the rate and extent of developmental and size-growth processes. May the writer be permitted in closing to again express his conviction that the amphibians afford the best opportunities for the accurate investigation of these questions. They should play a rôle in the study of these promisingly practical problems comparable to the part played by the insects in the field of cytology and experimental breeding. Indeed they are far closer home because they are vertebrates like ourselves—the forms nearest of kin in which these glands can be reached by operation at their inception, and in which feeding experiments may be carried on at an early stage of development.

AN UNUSUAL TYPE OF PROLIFERATION IN *AGROPYRON CRISTATUM*

C. V. Piper

The illustration shows a case of proliferation in *Agropyron cristatum* (L.) Beauv. which occurred in a plot of grass of this species at Redfield, S. Dak., in 1920. It will be noted that four of the spikelets are replaced by elongated leafy branches, a not uncommon teratological phenomenon in various species of Agropyron and other grasses, but in this example considerably longer than usual. In about twelve other spikelets the axis above the glumes is elongated and one or more of the lower lemmas appear as somewhat elongated bracts, the remainder of the spikelet being normal. In all of these modified spikelets the two glumes (empty glumes) remain unchanged—that is, exactly like those in the normal spikelets.

Proliferating spikelets—that is, those which elongate into leafy sterile branches—are very common in many grasses. Spikelets in which the axis elongates and only a few of the lower lemmas become sterile while the remaining ones remain fertile, seem not to have been reported. At least a search in the literature for such examples revealed no cases reported among grasses.

AGROPYRON CRISTATUM (L.) BEAUV.

1. Normal spike. 2. Normal spikelet. 3. Abnormal spike, four of the spikelets changed into leafy branches and twelve others each with the rachis elongated and the lower lemmas somewhat elongated. The glumes (empty glumes) remain normal in all the teratological spikelets. 4. Abnormal spikelet with the lower internodes of the rachis elongated. (Fig. 20.)

THE FIPPIN FAMILY IN 1876

Mr. and Mrs. James Fippin have this fortunate photographic record of themselves and their six children at three different periods, twenty years between each succeeding picture. In all three instances the members are shown in the same position. (Fig. 21.)

THE FAMILY MEMBERS IN 1896

James Fippin, the father in this group, was one of a family of three boys and two girls. One brother went to California where he settled with a large family; another brother also went to California with his family of eight children. The two girls married and lived in Ohio. All lived to notably old age. (Fig. 22.)

THE FAMILY AGAIN IN 1916

The six children shown with their parents in Fig. 21 and again in Fig. 22, are shown in this third photograph also in the same position. Forty years have elapsed since the first picture was taken. The "children" are now heads of families of their own, and the elder Mr. and Mrs. Fippin have 22 grandchildren and 25 great grandchildren. (Fig. 23.)

PHOTOGRAPHS SHOWING SAME FAMILY FROM YOUTH TO MATURITY

The three accompanying photographs are of the Fippin family. They are presented because of the rather unusual fact that they were taken twenty years apart—forty years between the first and last picture—with all the members of the family present in the same position in each picture. They are an interesting illustration of the unfoldment of personality over a span of forty years. James Fippin, (1) the head of the family, has lived for sixty years, just west of Columbus, Ohio, where he was a farmer. He was born in Belmont County, Ohio, January 31, 1833, and married Mary Shank (2) at Nashville, Ohio, March 16, 1854. After a few years at Nashville and a short residence in Indiana, they settled at what became with the opening of the Civil War, Camp Chase, and there the four younger of their six children were born.

John (3), the oldest son, (see numbers in the first picture) was a farmer for most of his life. Ambrose J. (4) was a farmer and carpenter. Mary Ann (5) married Frank P. Sperry, a seedsman; James E. (6) has been an accountant and banker; and Samuel (7) is an accountant, while Charles (8) is a mechanic. All now have families and reside in or near Columbus. There are 22 grandchildren and 25 great grandchildren.

The family has been unusually vigorous. Barring a period of severe rheumatism in his young manhood, both James Fippin and his wife have always been well. The latter died in October 1921 at the age of 87. The only other break in the family was that of Ambrose J. in 1919. Up to 1917 there had not been a natural death of any member of the family covering three generations. There were two accidental deaths.

James Fippin seems to be of English stock. His wife was a "Pennsylvania German."

THE SWAZEY BARBERRY

F. T. Ramsey
Austin, Texas

I WAS born in 1861 near the edge of the "bad" Indian country, fifty miles north of Austin, Texas. At that time one could not go to a store and buy flower seed. But mother, on that sparsely settled, lonesome prairie, wanted flowers. The only ones to be had were the native wild annuals, perennials, and shrubs. I have inherited from my mother the joy she had in gathering those shrubs to beautify the grounds of her first home.

How much easier it is for one to appreciate the value of a plant or shrub from a foreign country, whether recommended for ornament or economic use, than it is to see these qualities in native plants growing wild around you that have never received any aid in combatting the robbing roots or the smothering shade of other trees, or the drouths and freezes and floods that come in irregular attacks.

It often takes real effort to see refinement and beauty in a plant that you know is hardly beyond description, one that can be called climate-proof. This means more to a person living in an arid western environment than in the more humid East.

A line drawn north and south through Central Texas, passing through Austin, is generally considered to be where the arid and humid sections meet. A great number of shrubs not found elsewhere appear along this line and westward; while west of San Antonio is nearly desert, it has been said that between the Colorado and the Rio Grande rivers there can be found more kinds of plants and shrubs than in any other equal area. A lot of these plants bear what is called the trade-mark of West Texas—thorns.

There are a hundred sorts of wild shrubs that can be used to make one's home grounds beautiful, comfortable and valuable. There are leagues of barberries with countless variations in their leaves and fruits. The Mexicans and ninety-nine per cent of other residents call them "Agaritas," while some people call them "Chaparral," a name which in different sections is applied to a dozen different shrubs—by some people to any shrub that is armed or prickly.

Few persons who have lived a lifetime in the range of *Berberis trifoliolata*, the three leaved barberry, have noticed that, in going toward the center of its wide range, they may find here and there a bush with five or more leaflets called *Berberis Swazeyi*. Coulter's Botany of West Texas says some of these plants have from five to nine leaflets. The accompanying photograph shows them with five, seven, nine, eleven, and thirteen leaflets, and we found one with seventeen.

The colors of the leaves are as varied as their shapes. Some arê dark green above and silvery underneath, while the next bush may have these colors somewhat reversed. One will seem to imitate the silver or whiteness of "the old man's beard" on one side while on the other you may find one of a dozen shades of dark green or pea green, and so intense is the shade that they seem liquid in appearance. In spite of these differences when planted in a hedge and sheared they harmonize beautifully. They grow on any soil, and a sudden drop to zero temperature has no effect on them. I have never seen one dead from cold or drouth.

Whether or not all plants that have more than three leaflets should be called Swazeyi is a question for the botanists to settle, but the size and lateness of the fruit and the more upright growth of the bush distinctly separate this type from *trifoliolata*.

The Swazeyi berries of *Berberis Swazeyi* have scarcely begun to ripen when the last berry has ripened and fallen from the *B. trifoliolata*, which

A NEGLECTED FRUIT OF WESTERN TEXAS

Berberis Swazeyi, which grows wild in western Texas, merits attention because of its ornamental appearance, and the economic value of its edible berries, which are sometimes more than half an inch in diameter. It can be grown on almost any type of soil; it is not injured by zero temperatures, and it is very resistant to drouth. (Fig. 24.)

matures in April and May. The ripening period of *Swazeyi* extends to the end of June.

By spreading a sheet on the ground and cutting branches and whipping them together or paddling with a shingle, it takes but a few minutes to gather a gallon or a bushel of the berries. They make exquisite jelly.

The berries of *Berberis Swazeyi* are twice as large as those of *B. trifoliolata,* many of them measuring slightly over half an inch in diameter.

The bushes always bear some berries and rarely miss a full crop. I know one wild bush that has borne three gallons every year for thirty years except one.

A BEQUEST TO THE AMERICAN GENETIC ASSOCIATION FOR RESEARCHES IN HEREDITY

INSPIRED BY THE THOUGHT THAT "IT IS ONLY BY A GREATER KNOWLEDGE AND APPLICATION OF THE LAWS OF LIFE AND GROWTH THAT MAN CAN HOPE TO HASTEN HIS PROGRESS UPWARD"

THE strongest human instinct is that which perpetuates the race, and the highest of human ideals is the welfare of posterity. It is not lack of interest but lack of knowledge that interferes with eugenic progress. Not many people see the need, and there are very few who have a practical conception of the possibilities of improvement, to serve as a basis of constructive action. Charities and philanthropies of many kinds have had rich endowments for centuries, and especially "works of mercy" to care for the diseased or defective whose misfortunes wring our hearts. Few bequests have been made to increase the knowledge of heredity, although more knowledge is the fundamental need. Research in many subjects is being fostered by large donations, including subjects as far from any practical human interest as the remotest stars or the world of departed spirits. Yet we expect that our children and our children's children will go on living in this world, and we believe that the world will be a better or a worse place for posterity in proportion as right values of human life are established. The general lack of interest and support for human improvement renders it the more important that those who have deeper insight and keener sense of eugenic responsibility should seek for more effective ways of establishing and widening the influence of eugenic ideas.

The need of establishing better ideals of human welfare may be considered as the keynote of a remarkable testament received recently by the American Genetic Association. The way of making the bequest and the reasons that are given lend so much interest and value to this document that the testator has been requested to allow some parts of it to be published, and has given his consent, saying that "If anything I have written could be made the means of arousing new interest in any quarter I would be highly pleased."

Passing over the sections of the will that relate to appointment of trustees, settlement of obligations and personal bequests, the sections that explain the eugenic and educational convictions of the testator are as follows:

"I hereby give and bequeath unto the American Genetic Association located in the City of Washington, District of Columbia, the sum of ten thousand dollars, to be invested and reinvested by the Council of said Association and the net income therefrom to be used and applied by said Council without reservation for the increase and diffusion of knowledge regarding the laws of heredity. In the event, however, that the said American Genetic Association shall cease to exist or to continue engaged in the kind of endeavor for which this fund is bequeathed, the total amount of this bequest shall revert to the Smithsonian Institution located in the District of Columbia to be administered by the Trustees of said Smithsonian Institution in any way it sees fit for the increase and diffusion of knowledge regarding the laws of heredity. * * * *

"All of the rest, residue and remainder of my property, real and personal, and wheresoever situate, I give, devise and bequeath unto my trustee aforesaid, in trust, to carry out the provisions of this, my last will and testament according to my desires and wishes as hereinafter contained. * * *

"The fund created by the last paragraph of this will is to be devoted and used for beneficial purposes only, my wife and family and those coming after them to have the preference right

thereto, but never under any circumstances is such fund to be used wastefully or extravagantly or under such circumstances as to encourage idle or luxurious living. This property represents the savings of a lifetime of industry, economy, and self-denial, and I wish it to be used wisely and made to count for individual and race betterment.***

"As soon as my son is old enough for college, I desire that he be provided with the sum of $1200.00 per annum for his use during his college course, to meet his necessary expenses and to enable him to pursue his studies, but not to enable him to indulge in extravagancies or luxuries, should he happen to be so inclined. I hope that my son will marry early, say not later than the age of twenty-five, and trust that he will marry advisedly and know that his chosen mate comes from a family in which useful and capable men and women predominate. To assist and encourage him in his chosen pursuit or profession, I direct my trustee to pay to him at the time of his marriage the sum of five thousand dollars. I also direct that for each and every child born to him, before the termination of the trust created by this will, he be paid the sum of twenty-five hundred dollars as soon as each such child shall have attained the age of three years. Should my said son develop scholarly tastes and desire to devote his life to the pursuit of science and the acquisition of knowledge (and particularly along the lines of biology and genetics) and manifest a degree of ability along those lines (which might best be judged and determined by his original essays and papers appearing in scientific publications or by lectures before scientific bodies), then and in that case I desire that he have all of the money that he may need and use to advantage in the pursuit of the studies and researches, even to the limit of the income not otherwise appropriated. Should he desire to follow some business vocation in which capital is required, like agriculture, horticulture, live stock, mercantile or manufacturing pursuits, and manifest an ability in that direction, I desire that he be paid the sum of ten thousand dollars out of the income or principal of said trust when he shall have attained the age of thirty years, and, if he make progress in such pursuit or calling (my trustee to be the judge as to that) he shall receive ten thousand dollars additional when he shall have attained the age of forty years. If I shall have other sons who shall reach maturity, I desire that he or they shall receive the same benefits and that the same provisions shall apply as to each of them as are above provided for my present son.

"As to my daughter and any future daughters born to me, I desire that she or they shall have the advantage of a higher or college education, if such education be of a practical or beneficial kind, but I do not favor a smattering of music and art and the so-called accomplishments which often carry with them conceits, vanities and follies which later have to be unlearned at bitter cost. Neither do I want their minds taxed with the study of abstruse branches of learning which are of but little use and sometimes result in shattered nerves and weakened womanhood which lessens the possibility of happy and useful lives. I desire that they be taught the laws of health and beauty and how to preserve them; and also something of the laws of heredity. I desire also that they be taught that as this world was created for the evolution and development of man, their supreme duty and greatest glory consists in rearing of a family of noble sons and daughters; that the more nearly perfect they are themselves the greater the obligation which rests upon them in this respect. When it is remembered that college girls are frequently failures as wives and mothers; that recent statistics go to show that they average less than one child, each, it will be seen that I have good and sufficient reasons for not wanting to devote money to the conventional 'higher education' of women. A college education is a failure and race deterioration a certainty when the daughters of the best families in the

land fail in parentage. If my daughters desire the practical kind of education indicated, and there be an institution where such branches are taught my trustee is instructed to supply the means, otherwise nothing is to be expended for 'higher education.' At the time of marriage my trustee is instructed to pay to my daughter or daughters the same amount as provided for my son, and for each child born to her she is to receive the same sum to be paid according to the same conditions as above provided for my son. * * *

"In order to make myself better understood in this my last will and testament I desire first to explain that for many years I have held to the belief that wealth, especially great wealth, in the hands of any party should be regarded to some extent as a sacred trust for it has cost the life and labor of some one, perhaps of many, to produce it. While a man has a legal right to do as he pleases with what is his own, he does not always have the moral right to do so. Money or property wisely employed benefits the entire community, as well as the individual owner; unwisely employed it becomes a detriment to the community, and when devoted to idleness and luxury, or squandered in fast and riotous living it becomes a curse to the one who possesses it. This is so well understood by many that it has been well said that probably the worst thing that could happen to the majority of mankind would be to inherit wealth and to be relieved of the necessity of earning a living. Accumulated wealth in its power for good or evil might be compared to water gathered together in a storage reservoir; it can be made to turn the wheels of industry or irrigate a valley or do both at the same time, but uncontrolled and unguided it becomes a power for destruction, and out of its proper channel it soon becomes a torrent of mud, polluting and destroying everything in its path.

"Another thought which has possessed my mind for a long time is that every man should contribute something of his savings to some worthy cause, for it is only by so doing that we can repay the debt we owe to those sturdy pioneers of progress who by their unselfish efforts have, in all countries and ages, helped to make civilization possible. This thought has been confirmed and strengthened by the conviction, strong in my mind, that this world with its vast resources and powers, must have been created for a purpose, and that purpose must have been the evolution and development of man.

"The idea that the forces and powers of nature, chemical, mechanical and electrical and all of the vast supplies of coal, oil and minerals, were here to remain forever unused and unapplied, is to my mind unthinkable and as inconceivable as the idea of a great factory, equipped with modern machinery, being located in an uninhabited country.

"Man, then, being the object and purpose of creation, it becomes our duty to co-operate with nature in hastening the day of his perfection, for man is a creature of evolution, and still an unfinished product. To be as brief as possible, I am now convinced from some study and much thought, that it is only by a greater knowledge and application of the laws of life and growth that man can hope to hasten his progress upwards toward that happy day when weakness and sin will be reduced to a minimum and when the least efficient of mankind will be the equal of the greatest of today. Religion alone can never work this change, for polish and refine a man as you will, the work has all to be done over again with his son, for polish is not hereditary any more than the clothes a man wears. Religion at its best is but a crutch to help men walk, to aid the weak and wayward through this life.

"What the world needs is a race of men who are neither crippled in body or mind; for when men are born right, they will have no need to be 'born again.' Religion can help us to lofty ideals but we must look to science to

point the way to a realization of those ideals. Science has achieved wonders in the development of plants and animals, and it is high time now to turn attention to man himself, for he is subject to the same laws of life and growth. For thousands of years nature has been separating the sheep from the goats in her own harsh way. Under primitive conditions the weakest and least alert in body and mind were the first to fall, and progress was rapid. But nature is still on the job and while man today is no longer surrounded by wild beasts and savage foes with whom he has to battle with bare fists, yet he is surrounded with even more destructive and insidious foes in the form of temptations to excesses and indulgencies in hundreds of ways.

"We have all observed how quickly the savage races have fallen when suddenly exposed to the vices and temptations of civilization, and civilized man has by no means acquired immunity. In prehistoric times certain men and families were eliminated on account of their physical weaknesses and imperfections; now they are being eliminated for their vices and immoralities. Man killing monsters did the work then; fool killing vices do the work now.

"Under the earlier conditions man has refined physically; under the latter conditions he is being refined and perfected morally, for the man of the future must be strong in will power; the power of self direction and self control. The present age is perhaps the most critical and trying in man's career; it is a time when instinct is losing its hold and intelligence and will are not yet sufficiently developed to be a safe guide. As a race our present position might well be compared to that of the young man just out of college. Parents and teachers have done their part and his future success will depend largely upon his own efforts.

"As a race we have been reared in the lap of nature like other creatures, but the time has now arrived when our destiny is largely in our own hands and we must co-operate with all our strength to eliminate weakness and develop the "high minded man, with powers as far above dull brutes endued as brutes excel cold rocks and brambles rude." Race betterment is the all important work toward which our resources and energies should be directed and all other matters are significant only, or mainly, as they contribute to this grand purpose.

"I trust this brief philosophy of life will make me better understood by those who have known me and make my meaning clear in the foregoing disposition of my property."

Pseudo-Science

A Study of the Physical Vigor of American Women, by Edwin Elmore Jacobs, Ph.D., president of Ashland College and sometime fellow in sociology, Clark Univ. With an introduction by Charlotte Perkins Gilman. Pp. 60. Boston, Marshall Jones Co., 1920.

Dr. Jacobs seeks to prove the thesis that American women have become physically more vigorous in recent decades, and that this improvement is due to "release from former excessive household cares." This leads him to try his hand on some of the most formidable problems in the whole range of biology, with the result that he commits almost every sin enumerated in the "dont's for statisticians" and proves nothing at all. He presents some fragmentary, ill-interpreted, and often misleading data on women's diseases, the birth-rate, longevity and anthropological measurements, sizes of women's shoes, gloves, and corsets, and the participation of women in athletics. Very likely some parts, at least, of the American female population are improving in vigor. This may to some extent be due, as the author believes, to the declining birth-rate and the disappearance of home industries. But no light is shed on these questions by the book under review which, like very much of the "feminist" literature, is apt only to serve as a warning to a class in biometrics.—P. P.

WHAT IS MAN?

What is man? What is the defining characteristic mark of humankind? In the scheme of nature, what is the place—the distinctive place—of the human class of life? Have we propounded the question to ourselves? Professor Keyser thinks not, and in a brilliant address before the annual meeting of the Phi Beta Kappa Society at Columbia University discusses and expands a philosophy of life first sponsored by a Polish engineer, Count Alfred Korzybski.[1]

Humans, he points out, entertain two concepts of man, inherited in the mesh of inherited opinions; the one biological or zoological; the other mythological. According to the zoological conception man is an animal, a conception having at least the merit of regarding humans as natural—a merit not possessed by the mythological conception which accords man no place in nature, he being neither natural nor supernatural, but a kind of miraculous union or hybrid of the two.

Are these conceptions true? Or rather since they can not both be true, is one of them true? It should not be amazing to find that both are false; for the concepts are man's and their object is man; thus the difficulty is unique; it is that of a self-conscious being having to regard its kind as an object and rightly conceiving what the object is. If they are not true what is the error in these traditional conceptions? The error is believed to lie in a confusion of types. Plants, the lowest order of living things, are classed as the basic-energy-binding or chemistry binding class of life, while the animals are the space binders—the space binding class of life. What now of human beings, who, like the animals, have the capacity for binding space but with no capacity of a higher order would indeed be animals? The difference lies in the power of initiative, of creative ability, of imagination or reason, the power that makes progress possible, a power not possessed by animals. By virtue of that familiar yet ever strange human power, each generation inherits the fruit of the creative toil of bygone generations, augments the inheritance, and transmits it to the generations to come; then the dead survive in the living, destined with the living to greet and bless the yet unborn. Past, present, and future are not three; in man they are spiritually united to constitute one living reality and because this capacity *for binding time* under a law of ever-increasing amelioration is peculiar to man the class of human beings is to be conceived and scientifically defined to be the time-binding class of life. Not, as Professor Keyser points out, time binding animals, for time binding, chemistry binding, and space binding constitute three dimensions—three types of life to which belong man, plants and animals. Time-binding activity—the defining mark of man—may involve and often does involve space-binding as a higher involves a lower; but to say that, therefore, man is a species of animal—a time-binding species thereof—is like saying that a solid is a species of surface or that a violin is a species of wood or that symphony is a species of sound.

With this new conception of time binding, a study of man becomes the study of his time-binding energies; the laws of human nature are the natural laws of these energies. One of these laws is conceived as a law of perpetual growth and continued progress; a law of rapidly increasing geometric progression which reduces to the formula PR^{T-1} where P is the progress made in a given generation, R the ratio, and T the time. This then is the natural law for the advancement of civilization, only retarded in operation, the author believes, by the misconceptions man entertains of man, the misconception that man is but an animal and until man ceases to regard man as a species of animal the social life of the world and especially the ethical life will continue to be what it always has been in a large measure—zoological ethics.—J. H. K.

[1] Keyser, Cassius J., The Nature of Man, Science, Vol. LIV, No. 1393, pp. 205-213, Friday, Sept. 9, 1921.

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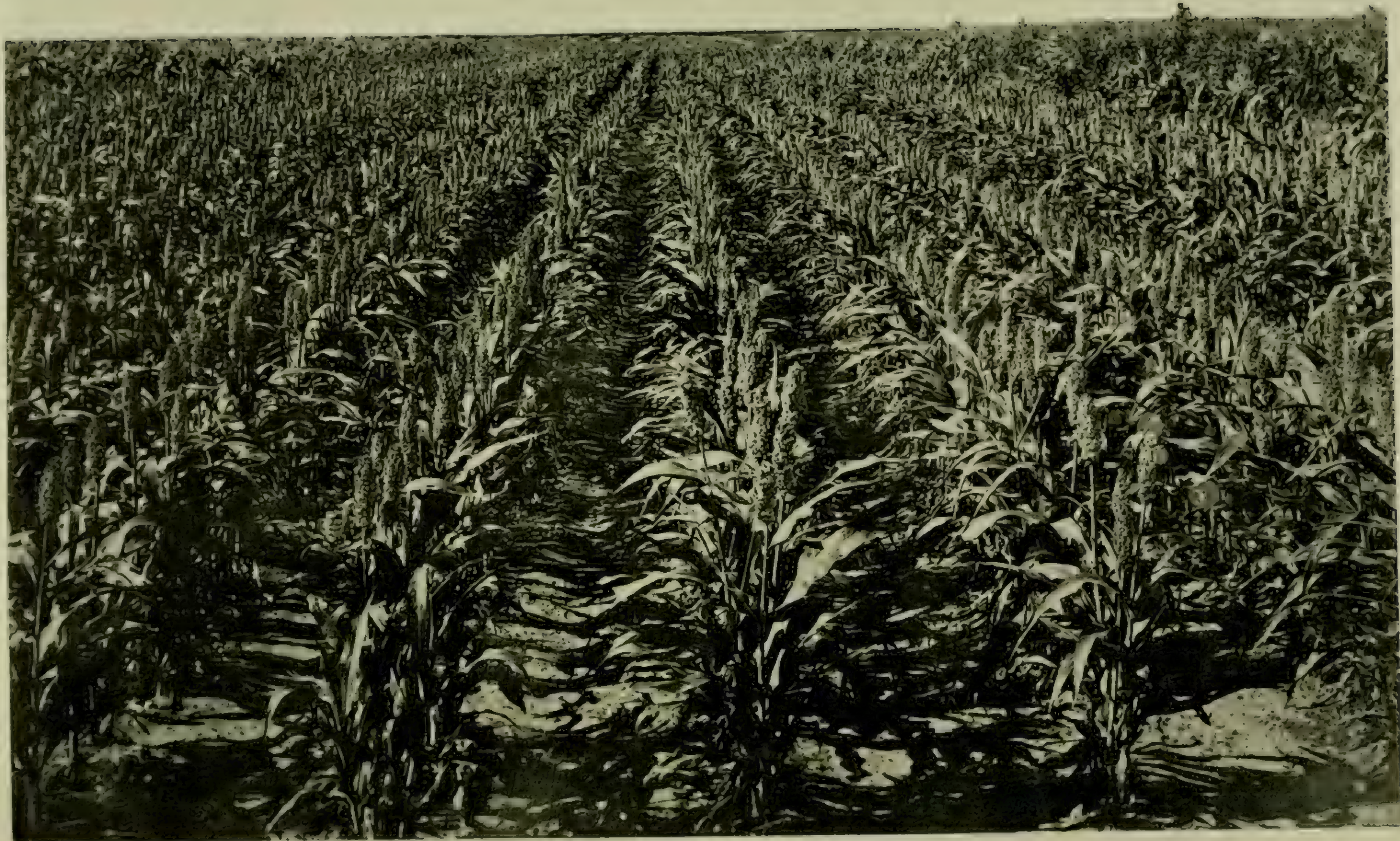


A HYBRID BETWEEN FETERITA AND KAFIR CORN

In recent years the Office of Forage-Crop Investigations of the U. S. Department of Agriculture has undertaken the improvement of sorghums through hybridization. The above photograph shows a selected strain of a feterita-kafir hybrid in the seventh generation. The uniformity of development exhibited by these plants is noteworthy. The photograph was taken at Chillocothe, Texas, in 1920. (Frontispiece.)

IMPROVEMENT OF SORGHUMS BY HYBRIDIZATION

H. N. Vinall and A. B. Cron[1]

Bureau of Plant Industry, U. S. Department of Agriculture

PAST work with sorghum hybrids in the United States has been limited very largely to the investigation and development of natural hybrids. The indifferent results attained in this way gave rise to the belief that there was little benefit to be derived from the hybridization of sorghums. Gradually the principal varieties have been purified and standardized by selection until their improvement in this way is about ended; at least the progress achieved by such methods is now extremely slow. Realization of this truth by those engaged in sorghum investigations has caused renewed interest in the possibility of improvement by hybridizing the best varieties.

Artificial hybridization of sorghums was begun by the Office of Forage-Crop Investigations of the United States Department of Agriculture in 1914 when the writers of this article made numerous crosses in the greenhouse at Washington, D. C., and in the field at Amarillo, Tex. Table I gives a list of these crosses.

Seeds from these sorghum crosses were sent to several Departmental field stations in the Great Plains in the spring of 1914 and the first generation grown that year. The second generation, grown in 1915, was studied carefully, but aside from being interesting genetically there was nothing very promising except from the crosses between feterita and milo and those between feterita and kafir.

Table I: Artificial Sorghum Crosses

Pistillate parent	Pollen parent	Number of cross-fertilized seeds
Dakota Amber sorgo	Johnson grass	1
"	Blackhull kafir	42
"	Sumac sorgo	39
Gooseneck sorgo	Dakota Amber sorgo	7
"	Blackhull kafir	19
Honey sorgo	"	24
"	Gooseneck sorgo	12
"	Sumac sorgo	16
Sumac sorgo	Blackhull kafir	24
Blackhull kafir	Dwarf milo	2
"	Honey sorgo	2
Dwarf milo	Feterita	44
Feterita	Sumac sorgo	4
" *	Blackhull kafir	2
Blackhull kafir	Feterita	2
Red Amber sorgo	"	2
Feterita	Red Amber sorgo	2

* The last four crosses were made by A. B. Cron at Amarillo, Tex., in the summer of 1914. All the other crosses were made by the senior author in the early spring of 1914 at Washington, D. C.

FETERITA-KAFIR HYBRIDS

The crosses between these two varieties were made during the summer and fall of 1914 by the junior author at Amarillo, Tex. Contrary to our expectations the F_1 plants had panicles with brown seeds. In shape and compactness the panicles were practically intermediate between those of Blackhull kafir and feterita. In appearance the plants were more like the kafir parent than the feterita. They were somewhat taller and the stems were a little greater in diameter, but on the whole the resultant plants were about what one would expect except for the color of the seed. The seeds of both would ordinarily be described as white,

[1] Mr. Cron formerly in charge of forage investigations at the Amarillo Cereal Field Station, Amarillo, Tex., has been since 1918, Superintendent of Texas Substation No. 12, Chillicothe, Tex. The forage crop investigations at this point are carried on cooperatively by the Bureau of Plant Industry and the Texas Agricultural Experiment Station.

although kafir seeds are specked with brown and the seeds of feterita are often marked with brown beneath the glumes. It is usually thought that the brown color on feterita seeds arises from a discoloration of the seed by its contact with the glume or hull. There may, however, be some color in the seed itself.

Segregation in the F_2 generation showed many widely diverse types from dwarfs about two feet tall to plants over six feet tall; the population varied also in leafiness, shape, and compactness of the panicle, size and color of the seeds, juiciness and sweetness of the stems, and many other characters. The several types selected for further trial were intermediate in most characters to the two parents resembling in many ways Dwarf hegari. (See Fig. 1.) In Table II is given in parallel columns a comparison of the F_7 of one of these hybrids with its two parents. Most of the types selected for increase and plat trials have bred true from the third generation. (Frontispiece.)

The general practice which is now being followed in testing these hybrids at Chillicothe, Tex., is as follows:

First generation.—The cross-pollinated seeds are planted in rows and all the heads of the F_1 plants are bagged to prevent cross-pollination.

Second generation.—All the seeds produced by the F_1 plants are sown in rows. As these F_2 plants mature selections representing the most promising types are made and the heads bagged for continued testing in comparison with the parents and other commercial varieties.

Third generation.—Head to row seedings of the F_2 selections are made, each row being duplicated at least three times with rows of the parent varieties included as checks. From the rows of hybrids, selections are made of the best plants and the heads bagged. If some rows appear to be particularly promising a sufficient number of heads are bagged so that a plat test of such strains can be made the following year. The other selections made are continued in row tests. In the third generation the row is judged as a unit if it shows decided uniformity in its general characters.

Fourth generation.—The most promising strains from the F_3 rows are seeded in duplicate plats which are protected from cross-pollination with other sorghum varieties by surrounding the plat with rows of some tall growing corn

TABLE II: COMPARISON OF A SEVENTH GENERATION SELECTED HYBRID WITH THE PARENT TYPES

PLANT CHARACTERS	♀ FETERITA (See Fig. 2)	F_7 HYBRID (See Fig. 1)	♂ KAFIR (See Fig. 3)
General uniformity	96	98	98
Height, inches	54–60	42–48	44–48
Diameter of stem, inches	½–⅝	⅝–¾	¾–⅞
Juiciness of stem	slight	medium-slight	medium
Sweetness of stem	slight	medium-slight	none
Branches of stem	few	none	none
Number of leaves	10	12–14	12–14
Color of leaves	medium green	dark green	dark green
Width of leaves	medium	broad	broad
Length of leaves	medium	medium	medium
Leaf sheath overlapping	none	much	much
Position of panicle	erect or slightly inclined	erect	erect
Shape of panicle	ovoid	ellipsoid	cylindrical
Exsertion of panicle	fully*	only ⅞	fully
Size of seed	large	intermediate	small
Color of seed	white	white	white
Hardness of seed	soft	intermediate	hard
Color of glumes	black	black	black
Growing season, days	90	92	95

* Exsertion of the head in feterita is often due to the bending of the peduncle away from the leaf sheath as in milo rather than extension beyond the leaf sheath.

HEADS OF FETERITA, KAFIR, AND HYBRIDS

This illustration shows two sorghums which have been used in making hybrids, and some of the resulting forms: on the extreme right is a head of feterita, and on the extreme left one of kafir; the five heads between them represent strains which have been selected from crosses between the two, and which are now being used in the work of developing forms desirable for extensive cultivation. (Fig. 1.)

(Fig. 4). In these plats the yield of grain and forage is the basis of final judgment as to the value of any particular strain. The other selections from F_3 plants are grown in head-to-row seedings as in the former year and if none of these selections now seem to be more valuable than the strains in the plat tests they are all discarded. Usually however one or two additional selections are found which appear worthy of plat tests.

Fifth generation.—The best strains as shown by the F_4 plat tests are grown in larger areas to increase the amount of seed if comparison with the parent varieties indicates that any of these strains are superior to the standard commercial varieties. Plant selection is continued in the other strains.

The hybrid described in Table II is a selected strain which is being grown as F. C. I. 8921. It has been produced under the selection system just described. The yields of this strain and two other feterita-kafir hybrids on the experiment station at Chillicothe, Tex., for the year 1921 are given in Table III

INHERITANCE OF CHARACTERS IN THE SORGHUMS

In connection with the improvement work genetic studies were made of the feterita-kafir and several other crosses. Lack of time and the feeling that the production of an improved strain was

TABLE III: GRAIN AND FORAGE YIELDS OF FETERITA AND KAFIR IN COMPARISON WITH THE YIELDS OF THREE HYBRIDS OF THESE VARIETIES

Serial No.	Variety	Air-dry forage yields per acre		Grain yields per acre		Relative yields of forage	Relative yields of grain
		1920	1921*	1920	1921	Ave. 1920-21	Ave. 1920-21
		Tons.	*Tons.*	*Bushels*	*Bushels*	*Per cent.*	*Per cent.*
811	feterita	2.24	1.32	31.4	21.0	97	104
8917	feterita X kafir	1.18	.90	34.3	29.2	57	127
8921	"	2.52	1.34	33.9	30.0	105	128
8929	"		1.53		29.7		
24983	Dwarf kafir	2.35	1.33	30.1	19.9	100	100

* Both grain and forage yields were rather low at Chillicothe, Tex., in 1921 on account of the poor distribution of seasonal rainfall. The stands and soil conditions, however, were alike, hence the yields are comparable.

A FETERITA PLANT

One of the plants used by the writers in the production of new sorghums is feterita, of which a mature plant is shown above. From this picture, a clear idea of the leaf, stem, and head characters of this crop can be obtained; it should be compared with the plant of Blackhull kafir, shown on the opposite page, since the latter was the other parent of many of the crosses discussed in the present paper. (Fig. 2.)

the real object to be kept in mind prevented a more comprehensive genetic survey of the very interesting and abundant material. However, the manner in which several minor characters were inherited was determined.

INHERITANCE OF SEED COLOR

Feterita X Red Amber Sorgo

The seed of feterita is bluish-white with limited areas of brown on some seeds. This color seems to arise from discoloration of the seed by contact with the black glume. Red Amber sorgo has seeds which are uniformly red-brown and this is dominant over the feterita seed color. The F_1 seeds are all red-brown like those of the Red Amber sorgo (Fig. 5). On the F_2 plants the segregation indicates that two independent unit factors are involved in the determination of the seed color. These two factors may be designated *R* (red) and *B* (brown).

The suggested formula for the two parents of the cross are, for feterita rrbb and for Red Amber sorgo RRBB. F_1 would therefore be RrBb with red-brown seed like those of Red Amber and F_2 would segregate into 9R-B- with red-brown seed like the Red Amber sorgo; 3 R-bb, plants with seed having only the red color; 3 rrB-, plants with seed having only the brown color on a white background; and 1 rrbb, plants with white seed like feterita.

The progenies of several crosses between feterita and Red Amber sorgo which were classified during the winter of 1916–17 conformed quite well with the two factor hypothesis giving a good 9 : 3 : 3 : 1 ratio. The results of this classification are given in Table IV.

Unfortunately some other progeny material of crosses between these same varieties classified later, gave results that are not in accord with the results in Table IV. There was a 3 : 1 ratio between red (red-brown and red) and not red (brown and white), the actual percentages being 75.9 per cent to 24.1 per cent. Separated, however, on the basis of brown and not brown, there was an excess of brown actually 80.2 per cent of this class. The difficulty seems to have been in the separation of the red-brown and reds, there

BLACKHULL KAFIR

Crosses between Blackhull kafir, of which a characteristic stem is shown above, and feterita, have given rise to new forms which have been selected to the seventh generation. The F_1 plants produced seed-panicles practically intermediate between the two parents in character, but in general appearance the plants more closely resembled kafir. (Fig. 3.)

A FETERITA—MILO HYBRID

In addition to the feterita-kafir crosses described in the present paper, the writers have hybridized feterita and milo. The above picture shows a selected strain of the feterita-milo cross, growing between rows of corn or maize to prevent contamination with nearby sorghums. The plants are noteworthy for their uniform size. (Fig. 4.)

TABLE IV: SEGREGATION OF SEED COLOR IN THE F_2 PROGENY OF CROSSES BETWEEN FETERITA AND RED AMBER SORGO

	Seed Color					P from 9:3:3:1
	Red-brown	Red	Brown	White	Total	
Feterita X Red Amber 8873–1–{2, 3, 4, 5}	1246	425	430	141	2242	.3
Feterita X Red Amber 8878–1–4	587	178	191	92	1048	.006
Red Amber X Feterita 8882–2–{1, 2}	432	155	147	45	779	.74
Totals observed	2265	758	768	278	4069	.46
Totals calculated	2289	763	763	254	4069	
Percentages observed	55.7	18.6	18.9	6.8	100	
Percentages calculated	56.25	18.75	18.75	6.25	100	

being a large excess of the former. There was also an excess of whites. Other material from crosses of these two varieties will have to be analyzed to fully establish the value of this hypothesis in regard to the inheritance of the seed color.

FETERITA X KAFIR AND KAFIR X FETERITA

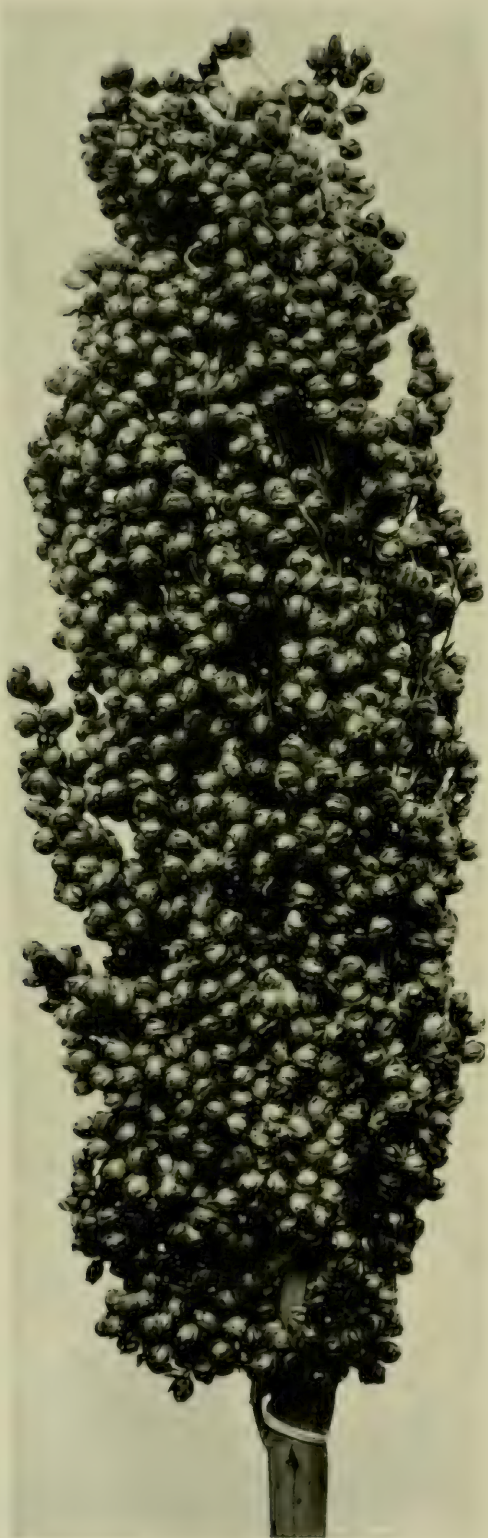
In studying the seed color in crosses between feterita and kafir it was apparent that here also two factors were concerned in the production of color. They did not prove, however, to be the same two that determined color in the Red Amber sorgo seed since the red color was not present in the progeny of the feterita-kafir crosses. The most plausible explanation is that the Blackhull kafir carries the factor *B* for brown color, but not the *R* for red and that feterita seed carries a factor *S* affecting color, but acting as a spreader of the brown pigment which is manifested

TABLE V: SEGREGATION OF SEED COLOR IN THE F_2 PROGENY OF CROSSES BETWEEN FETERITA AND BLACKHULL KAFIR

Serial No.	Name of Cross	Plants with		Per cent white	D/E
		brown seeds	white seeds		
8877–2–1	feterita X kafir	252	205	44.8±1.56	.67
8877–2–2	"	309	255	45.2±1.40	1.03
8880–8–1	kafir X feterita	179	79	30.6±2.08	6.30
8880–8–2	"	355	236	40.0±1.37	2.70
8880–8–3	"	224	133	37.3±1.77	3.60
8881–13–1	"	216	246	53.3±1.55	6.20
8881–13–2	"	135	122	47.4±2.08	1.70
Totals	"	1670	1276	43.4± .62	.56

TABLE VI: SEGREGATION OF F_2 PROGENY ACCORDING TO COLOR OF GLUMES

Glume Color	8882–7–1	8882–7–2	8882–7–3	8883–4–1	8883–4–2	8883–4–3	Totals observed	Per Cent	D/E
Red	542	226	509	547	575	436	2835	75.9±4.8	.19
Black	169	79	172	146	190	134	890	24.1±4.8	.19



in the kafir seeds only as small splotches or specks of red-brown. The genetic formula for the two sorghums would then be as follows: For feterita SSbb and for kafir ssBB.

If these factors acted independently F_1 would be SsBb, brown seeded with the brown color diffused or spread over the seed coat by the combination of the pigment factor *B* with the spreading factor *S*. This conforms to the results obtained since all the seed in the F_1 was uniformly brown with the color spread evenly over the seeds, most prominent on the outer or blossom end, but not collected in splotches or specks as it is in kafir. (Fig. 6.) F_2 according to the above theory would segregate into 9S-B-, 3S-bb, 3ssB- and 1ssbb. The S-B- representing 56.25 per cent of the total would be brown seeded like the F_1 seed; the S-bb would be white like feterita, the ssB- would be white like kafir with only brown specks, and the ssbb would also be white lacking both the factor for brown pigment and also the *S* factor. These last three phenotypes all being white make up 43.75 per cent of the total number.

The results obtained conform in the main very closely to this interpretation and are given in Table V.

INHERITANCE OF COLOR IN THE GLUMES

Red Amber Sorgo X Feterita

Red Amber sorgo has uniformly dark red glumes, while feterita has black glumes. In several crosses where the sorgo was used as the pistillate parent, it was found that the red in the glumes was dominant over the black. The results from

A SORGO-FETERITA CROSS

Above is shown a single head from an F_1 plant of the cross between Red Amber sorgo and feterita. It will be noted that the head is quite compact in form. The glumes are red, like those of the sorgo parent. (Fig. 5.)

the different crosses between these two sorghums were as follows: F_1 was uniformly red glumed like the Red Amber sorgo and F_2 segregated as shown in Table VI, indicating that there is but a single factor difference between red and black glumes.

INHERITANCE OF THE AWN

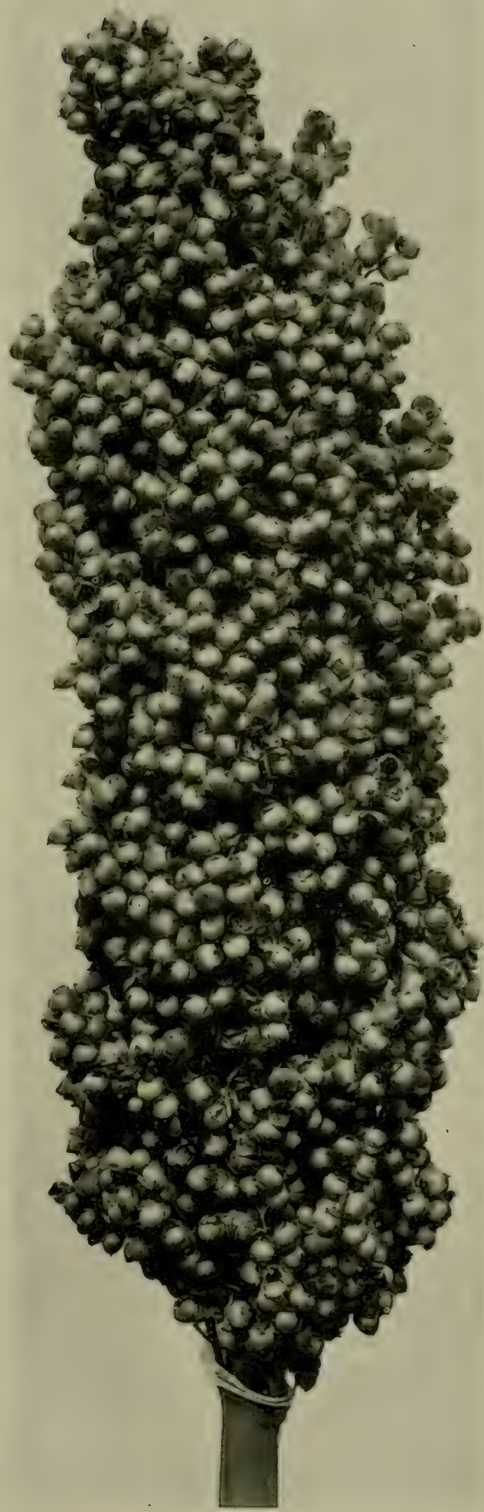
Dwarf Milo X Feterita

In milo the glumes are awned while in feterita they are not awned. In crosses between Dwarf milo and feterita it was found that the awn was a recessive character. In F_1 the seeds were unawned and in F_2 there were 183 plants with unawned seed to 68 that had awned seed. The calculated number of segregates would be 188 : 63 which approaches very closely the actual numbers obtained from the crosses. It would seem, therefore, that the awn in sorghums is a recessive character as it is in most of the small grains.

INHERITANCE OF SHAPE IN THE GLUME

Dwarf Milo X Feterita

Milo has a broad truncated glume which maintains an appressed position at the outer tip. Feterita glumes on the other hand are ovate with a rather acute tip which tends to become somewhat involute at maturity and bend away from the seed at the outer end. The progeny of the cross between Dwarf milo and feterita showed the broad truncated shape to be dominant over the narrower ovate shape of the feterita glumes. An analysis of the F_1 progeny showed that 187 plants had the truncated glumes, while 64 had the narrow ovate glumes. The calculated ratio would be 188 : 63.



A FETERITA-KAFIR CROSS

In shape and general characters this head, which was taken from an F_1 plant of the cross between feterita and kafir, resembles the feterita parent, but the seeds are light brown instead of white. (Fig. 6.)

POSITIONS AND MOVEMENTS OF COTTON LEAVES

How the Leaves Adjust Their Position to Varying Conditions of Illumination and of Soil Moisture

R. M. Meade[1]

THE leaves of the cotton plant are capable of definite movements which are made in direct reaction to sunlight. The movements of the leaves are governed by the pulvini in the blade and petiole, similar to those that determine movements in other plants. While the results here reported are of observations on plants of *Gossypium hirsutum* (Upland cotton) it has been observed that similar reactions occur in different degrees in other species of Gossypium.

SIZE AND SHAPE OF THE COTTON LEAF

The leaves of cotton seedlings are entire, but as the plant grows older there is a gradual change in leaf shape until the final leaves of the mature plants are deeply cleft with three to seven palmate lobes. The blades are nearly equal in length and width and vary from three to six inches in each dimension, with the petiole or stem about as long as the blade. The main veins are very prominent, especially on the lower surface of the leaf, and radiate from the junction of the blade with the petiole, extending to the tips of each lobe.

LOCATION, STRUCTURE AND FUNCTION OF THE TWO ORGANS WHICH CONTROL LEAF MOVEMENTS

The movements of the leaves in response to light are controlled by two organs located on the petiole of the leaf. These organs are the *basal pulvinus*, situated at the base of the petiole, and the *distal pulvinus*, at the end of the petiole.

The basal pulvinus, visible externally as a thickening of the base of the petiole, (See Fig. 7) differs structurally from the rest of the petiole in having less pith, more compact fibro-vascular bundles, and more fleshy tissue surrounding the bundles. Frequently the pulvinoid tissue attains an inch and a half in length and a diameter twice that of the rest of the petiole. Often there is no definite distinction between the pulvinus and the petiole proper, as the pulvinus tapers gradually to the diameter of the rest of the petiole. Sometimes, however, the change in size is more abrupt and distinctly marked. The function of this pulvinus appears to be that of controlling the movement of the petiole.

The distal pulvinus is composed of the upper part of the petiole ending with a callus or cushion at the junction of the principal veins of the leaf. The pulvinoid tissue of the upper portion of the petiole is generally not more than half an inch long and scarcely thicker than the middle of the petiole. A special feature of the distal pulvinus is at its attachment to the blade where it is contracted, leaving very little tissue around the bundles of the stem. The constricted portion acts as a pivot on which the blade may swing without greatly altering the position of the petiole.

The veins may be distinctly thickened for a distance of three-fourths of an inch from the base, and distin-

[1] All characters, whether morphological or physiological, of an important cultivated plant like cotton are of interest to breeders. Little has been done in comparing related species and varieties of plants in regard to their physiological characters and almost nothing is known of the inheritance of such characters, except as regards resistance to diseases. An interesting subject for investigation in this difficult field is suggested in this paper which is based upon a manuscript found among the papers of the late R. M. Meade.—R. D. Martin.

guished, like the callus, by a reddish color. The callus and thickened bases of the veins have a function in shifting the individual lobes, and may act independently to a certain extent, although generally functioning together so as to cause the blade to face the direct light.

INDEPENDENT AND SIMULTANEOUS ACTION OF THE TWO PULVINI WHICH ADJUST THE LEAF BLADE IN CHANGES IN DIRECT ILLUMINATION

The leaves of the cotton plant are heliotropic, that is, the blades move in such a way as to keep the upper surface perpendicular to the direct rays of light. The leaves gradually shift their positions as the direction of the light changes, leaves that are differently situated on the plant moving in different directions. The changes in position are governed by the pulvini, as already noted.

Both governing organs may function at the same time or each may act independently. The distal pulvinus may raise or lower individual lobes of the blade, or shift the whole blade while the basal pulvinus alters the position of the whole leaf. Under direct light the leaves are in constant but gradual motion. Thus the leaves are in a different position in the afternoon than in the morning, the blades facing east in the forenoon and west in the afternoon.

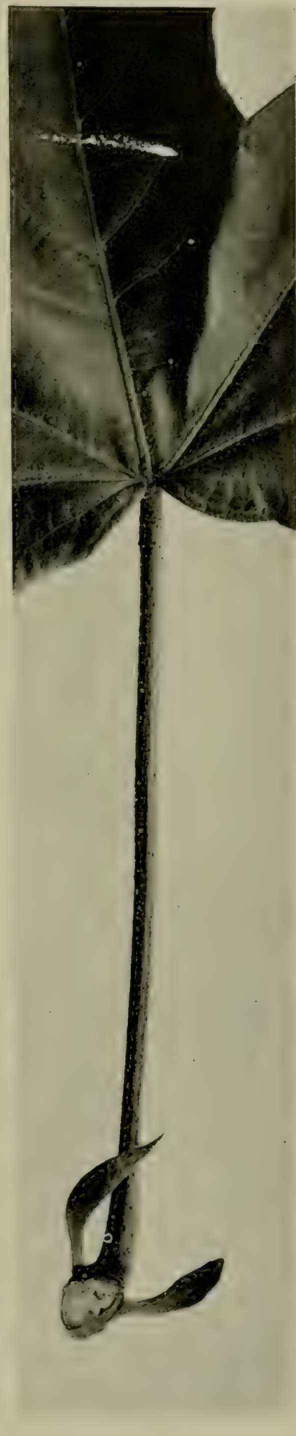
Movements are most varied on the side of the plants away from the direct light, where many of the leaves are in the shade. Here a single leaf usually requires the aid of both the distal and basal pulvini to adjust the blade and petiole. Some turn to the right and some to the left while others either rise or fall, according to the exposure to the strongest light. The blade or the petiole may take almost any position, the blades always moving to face the direct light. Often the blade extends straight out from the petiole, or is forced against the petiole on the under side. The petiole may take either an acute or an obtuse angle to the perpendicular.

POSITION OF LEAVES UNDER DIFFUSED LIGHT

In the diffused light of cloudy weather the leaves show practically no movement or differences in position and for this reason the position of the leaves common under diffused light is considered the typical day position. Under such conditions, regardless of the angle of the stems on which they are borne, the petioles stand at an angle of about 45 degrees from the vertical and the leaf-blade is usually flat, but on plants with large leaves they are somewhat folded at the sinuses.

NIGHT POSITION OF LEAVES DISTINCT FROM THAT ASSUMED DURING DAY

The leaves take a position at night



Petiole of a cotton leaf to indicate location of distal and basal pulvini. (Fig. 7.)

POSITION OF COTTON LEAVES AT NIGHT

The leaves of the cotton plant perform definite movements in reaction to light. These movements are controlled by two organs located on the petiole of the leaf: one, the pulvinus at the base of the petiole, and the other, the pulvinus at the distal or outer end of the same. The above photograph shows the position which the leaves assume at night: though they have the appearance of being wilted, the turgidity is actually greater than it is when the leaves are in the day position. (Fig. 8.)

A COTTON PLANT IN ITS DAY POSITION UNDER DIRECT LIGHT

This is the same plant as the one shown on the opposite page. The leaves are constantly adjusting their positions according to the directness of the sun's rays. The distal pulvinus located in the end of the petiole raises or lowers individual lobes of the leaf-blade, and the basal pulvinus changes the position of the whole leaf. "The leaves are in a different position in the afternoon than in the morning, the blades facing east in the forenoon and west in the afternoon." (Fig. 9.)

which is different from any position assumed in the daytime. (See Fig. 8.) At night the blades fall to a vertical position, the petiole remaining in the position common under diffused light except that the distal end bends slightly downward. The tissue of the blade between the primary veins folds a little outward and the tips of the lobes come closer together. The tips of the lobes may curl slightly toward the petiole, especially if the night temperature is considerably lower than that of the day. This night position is similar to that assumed by leaves that have become wilted, except that severely wilted leaves fold the lobes even closer together. The great difference is the condition of the tissue; at night the leaf is in a state of turgidity even greater than at any time during the day, while the wilted leaves are flaccid.

Under the influence of intense light acting for a considerable time, the leaves of the cotton plant often wilt or lose their turgor. The blade falls to a vertical position, with lobes deeply grooved or folded. The wilted condition is similar to that of a leaf that has been separated from the plant and is suffering for want of moisture. When in this condition transpiration is apparently checked and the leaf is in a state of rest.

Ordinarily only the *distal* pulvinus is affected when the leaves wilt. The upper part of the petiole curves downward and the blade remains in a drooping position until the light diminishes or a new supply of moisture is obtained. In some cases, however, the whole petiole becomes limp and falls with the rest of the leaf, though this seldom happens unless the light remains intense for a considerable length of time and the soil moisture is nearly exhausted. When a plant becomes wilted in this manner it is generally affected to such an extent that the leaves may never recover.

If light becomes less intense before sundown on account of cloudiness or for any other reason and a supply of moisture can be obtained from the soil, the tissue again fills with water and becomes turgid. The leaf then returns to the typical day position common under light conditions. (See Fig. 9.) After sundown the leaf gradually droops to the night position. When the light has continued intense throughout the day and the leaves have remained in the wilted state until nightfall, they retain the same relative position in the dark but soon become turgid.

The Delinquency of Women

A Study of Women Delinquents in New York State, by Mabel R. Fernald, Mary H. S. Hayes, and Almena Dawley, with a statistical chapter by Beardsley Ruml and a preface by Katherine Bement Davis. Pp. 542, with 225 tables and 46 charts. The Century Co., New York, 1920.

This study of 102 commitments at the state reformatory, Bedford Hills, N. Y., and comparable numbers from five other sources, is the most careful and detailed piece of work that has been done on the subject. The hereditary aspects are perhaps handled less satisfactorily than any others, such traits as alcoholism, suicide, criminal record, psychopathic condition, sexual irregularity, tuberculosis, venereal diseases and nomadism being thrown in together under this heading. More attention was paid to the social and educational background, and to the mental status of the offender. A cautious summary concludes that inferior economic background and somewhat inferior mentality are particularly characteristic of the women delinquents studied; all of which connotes poor home conditions, inadequate education, and industrial inefficiency. Further investigation might have shown that all these characteristics belong to a germinally inferior stock. Table 75, purporting to show that first-born children are in excess among delinquents, is based on an elementary statistical fallacy, ignoring the fact that there are inevitably more first-born children than any other kind in the whole population. But despite minor defects the volume remains a worthy monument to the Bureau of Social Hygiene, and an indispensable work of reference to those interested in delinquency.—P. P.

BREEDING WORK WITH BLACKBERRIES AND RASPBERRIES

H. Ness
Horticulturist, Texas Agricultural Experiment Station

OUR work with the genus Rubus, which has for its object the improvement of our cultivated blackberries and dewberries, was transmitted to me by my predecessor as Horticulturist to the Texas Experiment Station. The materials on hand in 1909, when I took charge, consisted of about a dozen varieties of blackberries and dewberries most commonly cultivated in our region. To these I added a few varieties of raspberries for the sake of pollen. As fruit bearers, raspberries are not dependable upon our grounds.

In looking the material over, I decided to begin the work by crossing those forms that showed the most opposed differences in characters, hoping thereby that the elements in the composition of the progeny might be more easily recognized and studied. As a second part of the project, I decided to grow as many seedlings from each variety as possible with a view to studying their variation and the opportunity for selection.

ORIGIN OF SPINELESS BLACKBERRIES

From the McDonald Blackberry, a native of Texas, introduced into cultivation by the Texas Nursery Company, 2,000 seedlings were brought into bearing. This variety has a diffuse, spiny growth, and is supposed to be a natural hybrid. The 2,000 seedlings fell readily into several more or less distinct groups, one of which was marked by its firm, almost coriaceous, smooth, lustrous leaves of 3 to 5 ovate-lanceolate, nearly entire-margined leaflets. In this group, two plants occurred with perfectly smooth shoots, as free from spines as an ordinary blade of grass. According to the general habit of growth of these two plants, I designated them, one as Spineless-diffuse, the other as Spineless-erect. From the Spineless-diffuse, I have grown four generations of seedlings; and, though cross-pollination with other forms was provided against in the first generation only, the majority of the progeny in each generation comes spineless and remarkably true to the spineless type in all other characters. My notes on the characters of the fourth generation give the following grouping of 200 young plants: 81 perfectly smooth, with all characters of the original type; 59 not smooth, with spines more or less evident, but otherwise typical; 60 plants not smooth, and of a different type.

The plants of the spineless group are readily recognized when very small by the form of the first leaf, which is cordate or cordate-lanceolate with entire or crenulate margins. The shape of these leaves is so similar to certain types of violets that they might, when young, be passed off on the unsuspecting as violets.

In crossing the Spineless-erect with the Early Harvest, two plants were obtained. The spineless form in one of these was so dominant that no traces of the Early Harvest, the mother, could be detected. This spineless F_1 selfed gave 77 individuals, in which the spineless grandfather was dominant, and 130, in which the Early Harvest, or the grandmother, was dominant. None were absolutely smooth, that is, without pubescence, as in the true spineless type, but the form of the first leaf of the 77 plants was true to that type.

EARLY HARVEST X AUSTIN MAYES

My first attempts at hybridization were, however, directed towards the combination of two forms that I

considered very suitable for my purposes, and from which I hoped for economic results of importance. These were the Early Harvest blackberry and the Austin dewberry.

The Early Harvest, assigned by systematists to *Rubus floridus*, has erect, fluted canes with few spines, tri-pinnate leaves, compact and elongated flower clusters with short bracteolate pedicels, and small flowers. The fruit also is small, but one of the sweetest, and the seed the smallest of any of the cultivated blackberries.

The Mayes dewberry, also called the Mayes Hybrid Austin and Austin-Mayes, referred to *R. baileyanus* x *floridus*, has a prostrate, diffusely branching growth with terete canes covered with a few rather small, straight spines. The leaves are 3 to 5 foliate; the flowers large, on elongated pedicels in loose, flattopped, bractless clusters. The fruit is large, composed of a few but large drupelets with very large seeds; the flavor is quite sour, and the aroma not perceptible.

From a cross between these two forms, Mayes being the mother, I grew to fruiting an F_1 generation of 28 plants. The characters of Mayes were so strongly dominant in all of them, as almost to exclude all traces of the other parent. All of these plants flowered profusely, and some produced many fruits which, however, were more or less imperfect and irregular in form, due to two kinds of drupelets, small and large intermixed, this being the most evident character of their hybrid origin.

An individual, in which the characters from both parents were more eivdent than in the rest, was screened off from foreign pollination. From the seed of this, an F_2 generation of 425 plants was raised. Of these, 367 had the characteristics of Mayes, 37 might be classed as intermediate, and in 21 the characters of Early Harvest were predominant. Two of the most typical of the last named group were screened. They flowered profusely but set no fruit. All other plants of that same generation, exposed to foreign pollen, were more or less sterile, or set imperfect and inferior fruit.

From the reciprocal cross, with Early Harvest as the mother and Mayes as the pollen parent, I failed to obtain any progeny; nor did I succeed any better with it as mother, using pollen from other sources.—The flowers of Early Harvest are strictly self-fertile and, generally, self-fertilized. —What bearing that fact may have on the difficulty of effecting a cross, I do not know.

For some years, I made numerous attempts to obtain crosses between various forms of our cultivated blackberries and dewberries, and failures resulted either from perfect or partial sterility; or the hybrids disgusted me, because of their confused characters as well as their utter failure to give any promise of improvement for economic purposes. In fact, they all bore the stamp of degenerates in that respect. I will only mention one of these cases, namely, a cross between the Mammoth blackberry and the Dallas blackberry.

THE MAMMOTH X DALLAS CROSS

The first generation of this cross consisted of 11 plants, with the vegetative organs uniformly intermediate between the parents. In the flowers, the following anomalies were noticeable: the stamens were much reduced in number and their filaments in length; the disk, upon which the stamens were inserted, had developed into a ring of papilla-like swellings bearing fascicles of pistils replacing a goodly number of the stamens. Such stamens as developed were, however, fertile to a considerable degree, since under screen fairly well developed fruits were obtained. In the second generation, this anomaly in the flowers increased, especially in those where the Mammoth characters were dominant. In some, the stamens had vanished altogether, and the accessory pistils had become perfect and fertile, developing drupelets of normal appearance when pollenized with pollen from the Logan blackberry (loganberry).

A CROSS BETWEEN THE LOUISIANA DEWBERRY AND THE BRILLIANT RED RASPBERRY

The plants which resulted from the cross between the Louisiana dewberry (*Rubus rubrisetus*) and the Brilliant Red Raspberry (*R. strigosus*) resembled the latter much more closely than the former. Some of them produced fruit of larger size than that of either parent. The field shown above contains seedlings of the F_3 generation. (Fig. 10.)

SEEDLINGS OF THE MCDONALD BLACKBERRY

The McDonald Blackberry is supposed to be a natural hybrid. It is diffuse and spiny in growth. Two thousand seedlings of this berry were grown, and they were found to vary considerably in character. They were classified in two general groups, one called Spineless diffuse, the other Spineless-erect. The young plants shown above are descendants of the Spineless-diffuse type (F_4 from the original stock of the McDonald). The plants on the left are spineless in character; those on the right, spiny. (Fig. 11.)

From this peculiar fruit, I obtained thirty-nine plants, in which all but one showed the characters of the Logan in their early youth; but as they were all lost during the first summer, I missed in this, as in many other cases, the opportunity to study them further.

SUCCESSFUL RASPBERRY-BLACKBERRY HYBRIDIZING

I had up to this time made frequent attempts to cross the blackberries or dewberries with various varieties of the raspberries, but without success, until I made use of seedlings of *Rubus rubrisetus* (Rydb.) as pistil plant.

A quart of fruit of this species was obtained from southern Louisiana in 1910. The seed was sown the same fall and gave rise to a large number of plants, quite uniform in general appearance. In 1913, a goodly number of flowers on various individuals of these seedlings were pollenized with the pollen from the Brilliant and Loudon, red raspberries. From this first combination with the *R. rubrisetus* as mother, which for short I shall call the Louisiana dewberry, or still more briefly the Louisiana, I raised twenty-one plants to be transplanted into the open field, and from the other cross with the same mother and Loudon as father, a few less.

The characters of the raspberry, *Rubus strigosus*, were strictly dominant in all the individuals of each lot, nor was there any discernible difference in the appearance of the two lots. In both, the plants were about equally infertile, though nearly all flowered at the proper season. The flowers varied somewhat in size on the various plants, the smallest being slightly larger than the raspberry, and the largest slightly smaller than the Louisiana berry. Whatever fruit set consisted of a few drupelets, irregularly distributed on the receptacle. The color was dark-red to almost brownish-black, when dead-ripe. Cross pollination was attempted between the various individuals, but did not result in more fruit.

For two years in succession, 1913 and 1914, the seeds were sown and a small number of plants as a second generation were raised each year; but no individual appeared more fertile, or more promising than those of the first generation. In 1915, the crop of fruit from this first generation was a little more abundant and gave rise to 280 plants, of which 125 reached bearing age in 1917. But, as the mother plants of the first generation were not screened from foreign pollination during flowering that spring, the true parentage of these plants was in doubt. Upon reaching maturity, I estimated them to fall into the following groups: 28%, raspberry dominant; 41%, Louisiana berry dominant; 22%, intermediate; and 3%, indefinable.

The group in which the raspberry was dominant, might again be divided according to vigor into two groups, very strong and very weak, with intermediates tending to either extreme. The next thing that caught my eye was that, in the more robust group of the raspberry-dominants, there were five plants setting perfect fruits, and with showing for a good crop on each plant.

These five plants differed from each other in no other feature, except that one, which I named the First Choice, was of a greater size, and, on that account, bore a larger crop of fruit. They were all coarse raspberry forms, with heavy ascending or prostrate, terete canes covered with numerous weak, short prickles. The leaves were very large, of raspberry texture with three to five broadly ovate to rotund, coarsely serrate leaflets. The

A DEWBERRY-RASPBERRY HYBRID

The Louisiana dewberry (Rubus rubrisetus), when crossed with the Brilliant red raspberry (Rubus strigosus), gave hybrids in which the characters of the latter were dominant. In the F_1 generation the plants were quite sterile, only a few abortive fruits being produced; in the F_2, however, five plants bore good crops of fruit. Leaves and berries of the F_2 generation are shown above. (Fig. 12.)

flowers were intermediate in size between those of the original parents, and borne on elongated pedicels in clusters similar to those of the Louisiana berry. The fruit was dark cherry-red at maturity and brownish-black, when overripe. The size of it was much larger than that of either of the original parents; in fact, larger than any Logan blackberry produced on our grounds. The flavor was mildly acid with a strong reminder of the raspberry.

Two plantings of the third generation are growing on our grounds; one, made in the spring of 1918, from seed produced in the open, the other, planted in the field in 1919, from seed produced under screen. The first consists of about 900 plants which fruited in 1919. In general appearance, these vary no more from each other, or from their mother-plants in the second generation, than may be expected from descendants of what is recognized as a true species. The variations, such as they are, consist mostly in vigor of the shoots, size of the leaves, size and abundance of the fruit, and the time and length of the fruiting period. The general type and characters of their various organs are the same.

According to these variations, I marked, from time to time, as the fruiting proceeded, twenty-four as elites; but as the season advanced, I dropped this number to 4,—among which, I am as yet undecided as to the preference.

As to flavor, form, and color of fruit, no positive distinction can be made. The fruit differs from both the blackberry and the raspberry in the mode of separating from the pedicel, inasmuch as this takes place at the base of the calyx, leaving the latter attached to the fruit. Because of this, the picking of the berries is a little difficult, since there is not a well defined node, where the disjointing takes place. No positive variation in this character has given opportunity for selection.

REMARKABLE LENGTH OF FRUITING SEASON

The four plants of the third generation, finally selected as elites, produced fruit from the middle of May to the middle of August; hence the length of the fruiting season during the past summer was about three months. Another noticeable character was, that the fruit did not perceptibly deteriorate in size or flavor as the season advanced. The later part of the crop was produced on shoots of the current season. This character, which results in a long season of bearing, is evidently inherited, in a great measure, from *Rubus rubrisetus*, where this tendency is present, but less evident.

The most remarkable part of these phenomena appears to me to be that fertility appeared only in the most robust group of those of the F_2 generation, in which the raspberry was dominant, and did not reappear, just as though sterility was merely a passing crisis.

Self-pollination, both in te fiveh plants of the second generation, and in their descendants of the third, was perfect under screen; and their pollen, when used in crossing even distantly related forms, gave rise to apparently good seed. I have also crossed both the second and the third generation with foreign pollen with excellent results. With the second generation plants as mothers, and McDonald Spineless-diffuse as father, I have three thrifty hybrid plants. With another form as mother, namely, Haymaker x Louisiana F_1, which in itself is very sterile, I have six very thrifty plants from seed secured in 1918. This combination is, therefore, (Brilliant x Louisiana) F_2 x (Haymaker x Louisiana) F_1.

Besides these, I have tried the pollen of the third generation in other crosses with surprisingly good results, so far as setting of fruit and production of seed are concerned. In short, the ease with which these plants lend themselves to hybridization with other forms astonished me, when I remem-

bered my previous difficulties and failures with some of their congeners.

As regards hardiness, both the second and the third generations have had ample tests on our ground and passed them without the slightest signs of discomfort. The drought and high temperature of the summer of 1918 was the severest in memory of even the oldest inhabitant, yet no individual in the entire third generation, of more than 900 plants, showed the slightest distress. The summer of 1919, has become noted for the opposite extreme, yet no deaths, or even diseases, have occurred among these plants.

FOR THE PROTECTION OF ANIMAL EXPERIMENTATION

THE JOURNAL OF HEREDITY wishes to call attention to the recent organization of the Committee for the Protection of Animal Experimentation. It is the intention to form a permanent organization of laymen and scientists. The purpose is "to protect the public against all measures which tend to lower the standards of medical education and to combat the mischievous propaganda of all the various cults whose activities jeopardize the public health, including of course, especially the anti-vivisectionists and anti-vaccinationists."

It is hardly necessary to say that the editorial board of the JOURNAL OF HEREDITY is in hearty sympathy with this movement.

It is an incontrovertible fact that the past progress in methods of curing diseases has been dependent, in the majority of cases, on experiments with lower animals; and in the nature of the case, the same must be true in the future. The alternative is progress by experimentation on human beings, sick or otherwise. Any form of treatment of sick persons is to some extent an experiment, but we naturally object to drastic experiments, made in ignorance, which mean almost certain death to the immediate subjects, even though there is a chance that in time knowledge may be obtained which will save many lives. Such experiments must be done with animals, with the elimination, of course, of all unnecessary suffering.

The modern theory of infectious diseases and the successful methods of prevention and cure to which it has lead in numerous cases, trace back directly to the experiments of Pasteur, Toch, Ehrlich and others with animals. Animal experimentation has also lead to better understanding and cure of deficiency diseases such as beriberi, and to the alleviation of functional disorders such as diabetes. Thousands owe their lives to surgical methods worked out at first with animals. Animals must be used in the standardization of useful but dangerous drugs, such as adrenalin and pituitary extract.

As geneticists, we believe that knowledge of the principles of heredity with respect not only to domestic animals and plants but especially to man himself is of the utmost of importance to mankind. It is very difficult to make progress in the direct study of human heredity. Eugenics must lean on experiments with the higher animals.

A number of statements have been issued by the above mentioned committee in which an illustration of the value of animal experimentation in the past is discussed at some length, and the importance to mankind of safeguarding it in the future is brought out by quotations from prominent men. The chairman of the Committee is Thomas Barbour, Boston Society of Natural History, 234 Berkeley St., Boston, Mass.

THE CHILEAN STRAWBERRY, AS GROWN IN ECUADOR

The region of Ambato, Ecuador, has long been famous for its strawberries, which ripen throughout the year. The variety does not appear to be distinct from that grown in Peru and Chile, but the fruiting season is longer than in the latter countries, because of the equable climate which prevails in the Ecuadorean Andes. The berries are remarkably uniform in shape, and have unusual shipping qualities. They are here shown natural size. In the center is a flower: it will be noted that it has both stamens and pistols, though *Fragaria chiloensis*, when cultivated in France, is said not to produce stamens. (Fig. 13.)

THE FRUTILLA, OR CHILEAN STRAWBERRY

Wilson Popenoe
Agricultural Explorer, U. S. Department of Agriculture

IN THE development of our cultivated strawberries, the frutilla (*Fragaria chiloensis* Duchesne) has played a major rôle. Large-fruited strawberries were not known in Europe previous to the introduction of this species in 1714. Up to that time, European horticulturists had contented themselves with the native wood strawberry (*F. vesca*), the Hautbois (*F. moschata* or *F. elatior*), and the Virginian strawberry (*F. virginiana*), which latter was not introduced from America until after 1600. All of these are small-fruited, though of good flavor and quality. By crossing with *F. chiloensis*, horticultural forms were developed which combined large size with delicate flavor, especially in those cases where *F. virginiana* entered into the combination. The varieties thus obtained were the progenitors of the cultivated sorts now grown not only in Europe, but also in North America and elsewhere.

Fragaria chiloensis is considered to be indigenous along the Pacific coast from Alaska to southern Chile, though the differences which separate some of the South American forms from those of North America are great, and further study may show that more than one species is involved. Regarding its occurrence in Alaska, Georgeson[1] writes, "It grows along the coast from Muir Glacier to Prince William Sound, and probably also in other places, but throughout this region it is quite abundant. Its favorite soil is the sand and gravel along the old beach line just above the reach of high water. It here disputes the possession of the surface with grasses and weeds of many kinds and is quite able to hold its own against them."

Farther south, on the coast of California, the species occurs abundantly in certain parts. Albert F. Etter[2] says, "In this region they are found only along the coastal bluffs and on sand dunes on the ocean shore. Of all fruit-bearing plants they are among the hardiest, being able to fight for existence among rough grasses and weeds, battling against harsh exposure and gales, and even salt spray from the breakers. . . . The foliage is dark green and heavy, tough and leathery in texture. The blossoms are large to very large, the male and female blossoms being borne on separate plants. This peculiar character, however, does not hold in the forms of the species found in other parts, those from South America being bisexual. The foliage of the southern form is also very distinct, being light green and fuzzy. Even such close points as Cape Mendocino and Point Arena have very different forms, while those from Alaska would hardly be recognized. The fruit varies as much as the plants in different regions. That from Chile and Peru is very large and often irregular in form, borne on long trusses, and of light pink or white color. . . . At Point Arena the fruit is borne on long trusses, is almost red, and is soft and fragile. At Cape Mendocino the fruit is pink, and borne on a very short truss."

EARLY HISTORY IN SOUTH AMERICA

Nowhere in North America is *Fragaria chiloensis* a cultivated plant. On the western coast of South America, however, it forms, in certain regions, an important culture, and has done so for several centuries. Frezier, who introduced the species into Europe, wrote in 1717 of its occurrence in Chile,[3]

[1] Georgeson, C. C. Annual Report, Alaska Exp. Sta., 1909.
[2] Ettersburg Strawberries, published by the author at Ettersburg, California, 1920.
[3] Frezier, M. Relation du Voyage de la Mer du Sud. Amsterdam, 1717.

THE STRAWBERRY FIELDS OF GUACHI, ECUADOR

Probably the most extensive strawberry plantations in South America are those located at Guachi, near Ambato, Ecuador. This region lies at an elevation of about 9500 feet; the climate is dry, cool, and equable, and the soil is a very sandy volcanic loam. Little cultural attention is given the plantations, and they are never irrigated; nevertheless, they produce, throughout the year, fruits of large size and delicious flavor. It will be noted that the plants have a dry, stunted appearance; this is one of the characteristics of *Fragaria chiloensis* as grown in Ecuador. When planted on rich soil, and irrigated abundantly, it makes luxuriant growth, but produces few fruits. (Fig. 14.)

"They cultivate fields of a species of strawberry different from ours in having more rounded, thicker and more hairy leaves; the fruits are commonly as large as a walnut, and sometimes the size of a hen's egg; they are whitish red and a trifle less delicate in flavor than our wood strawberries."

The historian Garcilaso de la Vega[4] records the introduction of the species into the highlands of Peru shortly after the Conquest. "Another fruit which they call Chili," he writes, "was brought to Cuzco in the year 1557. It is of very good flavor, and much used for presents. It is borne upon a low plant, almost trailing on the ground; it has little grains outside like the fruit of the madroño (arbutus) and is the same size, not round, but rather long, in the shape of a heart."

The Spaniards also carried the plant into Ecuador, though I have been unable to find any record of the exact year in which it reached that country. Father Velasco,[5] writing in 1789, calls it *frutilla*, or freza quitense (Quito strawberry), and says that the fruit is two or three times the size of the European strawberry. He adds "It is produced through the entire year, and although it is common in several provinces, in no other is it so abundant, nor so excellent, as in that of Ambato." Later writers, also, have praised the strawberries of this favored portion of Ecuador. Richard Spruce,[6] though mistaken as to the botanical identity and origin of the species, comments in the following interesting manner upon it: "The Everbearing Andean Strawberry, from the highlands of Mexico, is doubtless one of those varieties of *Fragaria vesca*[7] commonly cultivated throughout the Andes within the tropics, where the perpetual spring of that favoured region has had the effect of rendering the strawberry perennially fruitful, and many of the deciduous-leaved trees of Europe evergreen. In the equatorial Andes the province of Ambato is famed for its strawberries, which equal in size and flavour some of our best varieties, and are to be seen exposed for sale in the market-place of Ambato every day in the year."

THE STORY OF ITS INTRODUCTION INTO EUROPE

The introduction of *Fragaria chiloensis* into Europe, because of the important part it was destined to have in the development of cultivated strawberries, is worthy of more than passing notice. M. Frezier, a French officer, visited Chile in the year 1712, and spent some time in the region of Concepción, where he had opportunity to become familiar with this fruit. The classic Duchesne[8] gives the following account of his return to France and the successful introduction of the plant into that country:

"It is to the zeal and perseverance of this alert traveler that Europe owes this fine race of strawberries; I quote from his letter to me: 'I have returned,' says M. Frezier, 'in a merchant

[4] In the "Comentarios Reales," of which the first part was published at Lisbon, in 1609, and the second part at Cordoba in 1617. This is one of the classic works on the history of Peru.

[5] Velasco, Juan de. Historia del Reino de Quito en la America Meridional. Written in 1789, and published at Quito (Imprenta del Gobierno) 1844.

[6] Notes of a Botanist on the Amazon and Andes, London, 1908.

[7] While Spruce, who traveled in Ecuador during the years 1857–1860 (though his notes were not published until 1908), erred in considering this to be the species cultivated near Ambato, it is worthy of note that the true *F. vesca*, a native of Europe, has become naturalized in many parts of the Andean region, where it was doubtless introduced by the Spaniards at an early date. In the vicinity of Bogotá, Colombia, it grows abundantly at elevations between 6000 and 9000 feet, chiefly along roadsides and about cultivated fields, and the fruit is sold in the markets of the city nearly every day in the year. In Ecuador it occurs both wild and cultivated, but the fruit is not much used, the plant being esteemed more as an ornamental than for its berries. These are rarely more than half an inch long, and while somewhat dry, and at times possessing a slightly bitter taste, they are very good when stewed or made into a rich preserve, which latter is one of the favorite desserts of Bogotá. In parts of northern Ecuador *F. vesca* is called *frutilla*, but in the southern part of the country, where the true *frutilla* is grown, the correct Spanish name *fresa* is current.

[8] Duchesne fils, M. Histoire Naturelle des Fraisiers. Paris, 1766. The first published monograph of the cultivated strawberries, and a work of great importance.

vessel of Marseilles, owned by the brothers Bruny, and on which they had placed as supercargo their nephew M. Roux de Valbonne, who, after the Captain, had charge of the fresh water which was carried on board, and which is very precious on a voyage of six months duration, through the Torrid Zone; so that, if he had not been generous enough to have the plants, which were in a pot of soil, watered, it would not have been possible to keep them alive until we reached Marseilles.[9] Five of them arrived in good order, of which he took two, while I reserved three for myself. On my arrival at Paris, I gave one of these to my friend M. Antoine Jussieu, to be planted in the Royal Garden; one to M. le Pelletier de Souzy, our minister of fortifications, and the third I retained.' " Frezier later published, in his "Relation du Voyage de la Mer du Sud" a drawing of the plant and its fruit, with the title, "Fragaria chiliensis, fructu maximo, foliis carnosis, hirsutis, vulgo frutilla" and below, "Fraise du Chili dessinée de grandeur naturelle."

Duchesne remarks that, after the introduction of these five plants, "the *frutiller* was soon disseminated throughout Europe." In his discussion of the establishment of the species in France, he accounts for only three of the five specimens brought by Frezier. The two which were taken by M. Roux de Valbonne do not again figure in the story. Very soon after its introduction, the species was cultivated commercially in the vicinity of Brest, but in 1766 its importance had greatly declined, according to Duchesne, because the plants were unproductive. Evidently many of them were pistillates, instead of hermaphrodites; in fact, Duchesne thinks that all of them may have been so, and that fruit was only produced when they were supplied with pollen from one of the other species then cultivated in France. So far as I have observed, the plants cultivated in Chile, Peru and Ecuador always produce perfect flowers; can it be that the unaccustomed climatic conditions to which they were subjected in France caused them to abort the stamens?

At this point it is of interest to consider the derivation of the name given to the species. Frezier, who published his book in 1717, calls it "Fragaria chiliensis," while Duchesne, who monographed the strawberries in 1766, changes it to "Fragaria chiloensis." The island of Chiloe, which lies off the coast of Chile between latitudes 42 and 44 S., approximately, is one of the regions in which this large-fruited form occurs as an indigenous species, and the logical assumption would be that the specific name *chiloensis* was formed from that of the island; yet Duchesne says nothing to this effect, and the fact that Frezier, in his earlier work, uses the form *chiliensis* shows that he, at least, desired to name the species after the country, Chile, instead of for the island, Chiloe.

Several authors give *quelghen* as the indigenous name of the fruit. *Frutilla* is the term universally employed for the species by Spanish-speaking people on the western coast of South America; the Spanish name of the European strawberry, *fresa*, is reserved for the fruit of *F. vesca*. A strawberry field, if the plants are of the *chiloensis* species, is termed a *frutillar*, and there is a town by this name in southern Chile. In the United States the names Chilean strawberry, sand strawberry, beach strawberry, and probably several others have been applied to the species.

PRESENT STATUS OF FRAGARIA CHILOENSIS IN SOUTH AMERICA

The horticultural importance of this strawberry in South America is considerable. I have not been in Argentina to determine whether or not it is cultivated there, but on the western side of the continent it is grown in nearly every country. Beginning in the north, it is cultivated in the vicinity of Bogotá, Colombia, though not extensively so. In the months of Decem-

[9] The 17th of August, 1714, according to J. H. Blanchard, who gives a detailed account of the Frezier voyage in the Journal of the Societe Centrale d'Horticulture de France, XII, p. 628, Paris, 1878.

A GROUP OF ECUADOREAN STRAWBERRY PICKERS

Fragaria chiloensis is the most remarkable of all strawberries, in so far as shipping qualities are concerned. It is the custom, in Ecuador, to throw the fruits into boxes such as the one here shown: they are then carried six or seven miles on mule-back to the city of Ambato, where they are sorted by hand, and packed in baskets holding two to six quarts, for shipment by train to Quito or Guayaquil. There is probably no other strawberry in the world which would tolerate this sort of handling. (Fig. 15.)

THE CHILEAN STRAWBERRY IN THE HIGHLANDS OF PERU

In the valley of the Rio Urubamba, not far from Cuzco, the ancient capital of the Incas, the Chilean strawberry is grown on an extensive scale. Many of the plantations, including the one here shown, have been made upon *andenes* or agricultural terraces which were constructed in prehistoric times. In this region, which lies at an elevation of about 9000 feet, *Fragaria chiloensis* does not fruit throughout the year, as it does in Ecuador. This photograph was taken near the village of Yucay, looking down the valley toward the town of Urubamba. (Fig. 16.)

ber and January the fruits are occasionally offered in the markets of that city, prepared for sale in a unique fashion: they are gathered with long stems, and then tied together one above the other to form strings a foot or two in length. The common name *fruta de Chile* is applied to the species in this region.

I have not seen the species in the western part of Colombia, but farther south, in the highlands of Ecuador, it is extensively cultivated, mainly in the region of Guachi, a settlement not more than six or seven miles from Ambato. Here the plants bear fruit throughout the year,—a characteristic which they do not exhibit in Peru and Chile, probably because of the utter lack, in Ecuador, of well-defined seasons.

Guachi lies at an elevation of 9500 to 10,000 feet, and is a series of rolling hills, almost devoid of trees, with a soil which can be characterised as a very loose, fine, sandy loam of volcanic origin. The strawberry plantations cover an area of at least 60 acres; the plants are never irrigated, and the rainfall is probably not more than 15 inches per annum. The temperature is rarely higher than 65° or 70°; and seldom lower than 35° F. above zero. Severe frosts are unknown. Three times a year the fields are cleaned of weeds with a heavy hoe, this being the only cultural attention which they receive. The plants never grow to large size. The natives assert that when irrigated they make luxuriant growth, but do not yield abundantly nor is the fruit large and sweet; and this has, indeed, been observed by me to be the case when plants from Guachi are taken to Ambato and there grown on rich loamy soil under good cultural conditions.

The fruit is harvested at Guachi once a week throughout the year. There are, however, three seasons when the most abundant yield is obtained, these being in February, in August, and in December. The method of handling the berries is primitive; they are carried to Ambato in wooden boxes holding 30 to 35 quarts. Women in the market place grade them by hand, and pack them in baskets of varying sizes, for sale to passengers on the Guayaquil—Quito trains which pass through the town, or for shipment to these and a few other points.

In size, shape and other characteristics the strawberries of this region are remarkably uniform. They are oblong-conical in outline, sometimes oblong-ovoid, and from one to two inches in length. When fully ripe they are light red in color, with firm, meaty, pinkish white flesh. The flavor is perhaps not quite so aromatic and sprightly as that of some of our best North American and European strawberries, but it is very delicate and pleasant. For canning and shipping purposes the Guachi strawberry far excels any of our own. What sorts have we, may I ask, which could be thrown into boxes holding 30 to 35 quarts, carried seven or eight miles on mule back, worked over by hand and packed in two to six-quart baskets, and then shipped down to a tropical seaport, there to be kept in the market for two or three days at a temperature of 70 to 85 degrees? Even with such treatment as this, the Guachi strawberry holds up well, retaining its shape and texture to an extent altogether unknown among northern strawberries. This same characteristic shows up strongly when the fruit is canned or preserved; the berries retain their form and size nearly as well as do peaches,—far surpassing in this respect any of our North American strawberries—and have a very delicate flavor. In comparing a tin of the preserved fruits brought from Chile, however, with a good North American pack, and with preserved strawberries of the Portia variety, George M. Darrow and myself both thought chiloensis, as represented by this sample, not so richly flavored as the best of our own sorts. It has delicacy, and, in the fresh state, a delightful, though rather faint, aroma; but it has not sufficient acidity to make a really excellent canned fruit.

CULTIVATED IN THE HIGHLANDS OF PERU

In Peru, there are numerous plantations of chiloensis in the valley of the

A STRAWBERRY FIELD IN CENTRAL CHILE

Near the town of Quillota, not far from Valparaiso, *Fragaria chiloensis* is extensively cultivated to supply the canning factories which have been established in this region. Here is shown a young peach orchard in which strawberries have been planted as a secondary crop. Chilean growers irrigate their strawberry fields, and as a consequence, the plants make more luxuriant growth than they do on the dry plains of the Ecuadorean highlands; but the fruit produced is perhaps not so highly flavored as that of Guachi, Ecuador, nor do the plants bear throughout the year as they do in the latter region. The ripening season in central Chile extends from the first of December to the end of January. (Fig. 17.)

Rio Urubamba, not far from the city of Cuzco, at elevations of 9000 to 9500 feet. Several of the best are near the village of Yucay, on large *andenes* (artificial terraces) built in the days of the Incas. Here the plants are more vigorous in growth than at Guachi, but the fruiting season is not nearly so long; I am told by T. E. Payne of Calca that the first fruits ripen about October 20, and the last ones about the end of January. The crop is marketed in Cuzco. I was not able to see ripe fruits grown in this region, but from descriptions given me I judge they differ very little from those of Ecuador.

In central Chile there are numerous plantations, from which the fruit is either shipped to the markets of Santiago or used for canning and preserving. In one field which I examined, not far from Santiago, the plants were exceedingly robust and vigorous in appearance, both leaves and flowers standing upon stems six to ten inches long. The appearance of such plants is quite different from those of Guachi, Ecuador, where the leaves rarely stand more than three or four inches above the ground, and where the plants have a dried-up, starved appearance, but where, nevertheless, excellent fruit is produced throughout the year. In Chile, as in Peru, only one crop is obtained. The principal season in the vicinity of Santiago and Quillota is said to be December and January.

Two varieties are commonly recognized in Chile,—the common, light red one, and the *frutilla blanca*, whose fruit is ivory white to very pale pink. The red form is cultivated far more extensively than he white. From having examined the canned product, I judge that the size and character of the Chilean-grown fruits is not markedly different from that of the Guachi berries, but I am inclined to believe that the latter may be a little sweeter and more delicately flavored. There are several canning factories in central Chile, which turn out preserved strawberries as well as strawberry jam.

Because of the fact that no attention has been given to isolating good varieties of this berry, and because of the general confusion which surrounds horticultural matters in western South America, it is impossible to state just how many distinct forms of chiloensis exist in the several countries above considered. Certain it is that few well defined varieties are generally propagated or recognized by the inhabitants. In this connection it may be mentioned that a given variety of strawberry may sometimes change its shape and character when grown in different climates. Klondike, for example, is conic in Florida, globose farther north, and long conic and necked in California. Marshall bears but one crop in New England, but fruits throughout the summer in California. We can not assume, therefore, that the long fruiting season of the Guachi strawberry really constitutes a difference between that variety and the one grown in Chile; it is doubtless an effect of the almost total absence of well-defined seasonal changes, either of temperature or rainfall, which prevails on the Equator.

PROBABLY THE WORLD'S OLDEST CULTIVATED STRAWBERRY

Fragaria chiloensis of western South America is certainly one of the oldest cultivated strawberries in the world. I have seen no reference in literature to its horticultural status at the time of the Conquest: the indigenous inhabitants may have cultivated it since time immemorial, and even if they did not, it can safely be assumed that it has been grown in gardens since the colonization of Chile by the Spaniards. In all this time only two well-defined varieties seem to have appeared, the red-fruited and the white-fruited. The first-named has been cultivated continuously in the highlands of Peru since 1557,—nearly four centuries. This offers a rather striking refutation of the argument that strawberry varieties "run out." Those which have been produced by hybridization may change their character or "run out" in a relatively short time,—I do

not know the facts of the case,—but certainly it cannot be said that the red-fruited form of *F. chiloensis* which is cultivated in Peru and Ecuador shows any signs of so doing!

Duchesne writes of this species that it is more robust, and larger in all its parts, than any of the other strawberries, and that it makes the slowest growth of all, some plants not flowering until they are five years old. It does not produce runners as freely as the horticultural varieties now grown in North America. The flowers, particularly those which appear at the beginning of the season, stand high above the ground on thick, hairy stems, and are fully an inch in diameter. When a field of this species is in full bloom it is almost as fragrant as an orange grove.

Fletcher,[10] in describing the principal characteristics of *F. chiloensis*, says: "The plant is large, stocky, densely hairy, with large blossoms. It throws out a moderate number of short, stout runners mostly after the fruit has matured. The roots are rather thick, fleshy, and usually are more superficial than those of *F. virginiana*. When a plant grows in the same place for several years the crown does not divide low down, as in *F. virginiana*, but makes several large crowns high up, all attached to the main root stalk. The plant is pushed upward out of the soil and new roots form above the old ones."

We have it on Duchesne's authority that the stamens are abortive, and that no pollen is produced. This certainly is not true of the species as it grows in South America. The fruits, because of their large size and unusual texture, have been, and will continue to be, of great interest to strawberry breeders in North America, Europe, and other regions. It is doubtful if the varieties which are cultivated in South America will be of great value to us, for commercial purposes, until they are crossed with forms better adapted to our climatic conditions. There is no region in the United States with a climate approximating that of Guachi, Ecuador; the distance which separates us from the Equator precludes all possibility of such a thing. We can not, therefore, expect the Guachi variety to fruit throughout the year in any part of this country.

Certain sections of California are very similar to central Chile, in so far as climate and soil are concerned. The region of Santiago has about the same summer climate as Los Angeles, and a winter which is sometimes, but not often, a few degrees colder. The Chilean varieties may, therefore, succeed in southern California, but if they produce fruit only during two or three months of the year, as they do in Chile, they will not be commercially valuable to us. They will, however, be useful to breeders, and from this point of view the value and importance of the horticultural forms from South America cannot be over- mphasized. They will give size, texture, and perhaps, ability to resist drought, to many of our important strawberries of the future. One breeder goes even further: Albert F. Etter of California, whose work in strawberry improvement is noteworthy and entitles him to speak with more than ordinary authority in such matters, ventures the prediction that the "most exquisite flavors the strawberry will ever know will be derived from the various forms of the chiloensis species."

[10] Fletcher, S. W., The Strawberry in North America, New York, 1917.

NATURAL HYBRIDIZATION OF WHEAT AND RYE IN RUSSIA

G. K. Meister[1]

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IN 1918 at the Experimental Station in Saratov, in southeastern European Russia, a truly extraordinary phenomenon was witnessed of the mass appearance of natural hybrids (F_1) between wheat and rye, in a number of plots of winter varieties of wheat (*Triticum vulgare* v. *erythrospermum*, v. *Hostianum* and v. *pyrothrix*). The number of these hybrids was not the same in all plots. They were altogether absent in some; in others they were occasional; in still others their number was considerable; while in the plot No. 648, v. *erythrospermum*, 20% of the plants were hybrids. Altogether many thousands of natural wheat-rye hybrids were observed.

The plots in which a large number of hybrids occurred are characterized by early ripening, and if they do not flower simultaneously with the rye, the period of their blooming, at any rate, partially coincides with the blooming of the rye. These varieties of wheat have a considerable opening of the flower glumes in blooming, which facilitates natural hybridization.

The climate of Saratov is continental and dry, with a precipitation of only about 380 mm. The natural hybridization of wheat here is such a usual event that in 1919, for example, we collected over three hundred plants of hybrids (F_1) between *Triticum durum* v. *hordeiforme* and *Triticum vulgare*.

It should be added here that 1917, the year preceding the appearance of the wheat-rye hybrids, was a particularly dry year; and also that in order to avoid their cross-pollination, the varieties of wheat were separated by protecting rows of rye—in short, all conditions favorable for the formation of hybrids were present.

The mass appearance of hybrids in the plot No. 648 should be attributed to the peculiar biological character of this variety of wheat. This variety is characterized in general by weak frost resistance. The hybrids (F_1), on the other hand, so far as frost resistance is concerned, are more like the rye. They survive even in places where winter wheat perishes entirely. This fact was further attested by the behavior of the hybrids in their later generations.

We were successful in collecting a considerable number of hybrids in 1919 and 1920, and in this way we have assured the work with them also for the future.

From the botanical point of view, the wheat-rye hybrids of the first generation occupy an intermediate position between *Secale* and *Triticum*, in the majority of their features, with a certain predominence of wheat properties. The general habit of the plant is that of wheat rather than of rye, but in the majority of the culms the upper part of the peduncle just below the base of the ear is hairy like rye.

In literature on wheat-rye hybrids, beginning with *Rimpau* descriptions are given of the first generation (F_1) of these plants so we shall not describe them in this short note.

Let us turn to the fertility of the hybrids of the first generation: As was

[1] Translated from original manuscript in Russian by Prof. N. I. Vavilov.

Note: In reference to the natural hybridization of wheat and rye, which is the subject of Mr. Meister's article, it will be of interest to recall that Dr. C. E. Leighty reported in the Journal of Heredity for March 1920 that the season of 1917 at Arlington Farm (near Washington, D. C.) seemed to be uncommonly favorable for cross pollination of cereal varieties, 19 natural wheat-rye hybrids (F_1) being found in 1918, while cross pollinations between different varieties of wheat occurred in unusual numbers; and likewise crosses between varieties of barley.—Editor.

shown by the investigations of Tschermak, Jesenko and others, these hybrids are generally sterile, which is explained by the irregular division of cells in the pollen. The stamens are insufficiently filled with pollen, are covered with thick films and in the absence of the necessary turgor generally do not dehisce. The pollen is amorphous, for the most part, but frequently there can be found some pollen with well defined nuclei and firmer granulation. Like Jesenko, we did not succeed in obtaining self-pollination in hybrids. There were 220 isolated heads which did not yield a single seed.

Still, during a period of three years about 1200 seeds were obtained from these hybrids. The number of heads with seed varied in different years from five to ten per cent of the total number of heads, there being generally not more than one seed to a head, rarely two or three. The seeds are of the wheat type, but occasionally somewhat elongated, approaching the shape of rye.

Here arises the question: If self-pollination in hybrids (F_1) is impossible, how were the seeds obtained by Rimpau, Carmen—and at our station? Dr. Jesenko explains the derivation of the seeds as being due to the crossing of the hybrids with rye and wheat, the possibility of which he proved by experiment. In a test made at our station in 1919 with 970 flowers pollinated by wheat, we succeeded in obtaining five seeds; 1012 flowers pollinated by rye gave one seed. In 1920, on pollinating 870 flowers with rye, not a single seed was obtained; while 220 isolated heads also failed entirely to yield seed. So far everything goes to prove that seeds are obtained in first-generation (F_1) wheat-rye hybrids only when their flowers are pollinated, preferably by wheat, or sometimes by rye pollen. But on account of certain considerations, we believe this matter has not been sufficiently cleared up.

I shall now consider the hybrids of the second generation. Germination of the seeds is about 70 to 80 per cent; the shoots are coloured or not coloured with anthocyanin; albino plants were noticed in the progeny of only one plant. The winter form of the hybrid plants varies considerably—from a rosette with stalks pressed to the ground, to an upright bush with non-spreading stalks; not infrequently the plants have narrow needle-pointed leaves, like those found on certain wild grassses. But these forms usually perish in the autumn.

The plants vary greatly in the length and width of the leaf blade, exceeding by far the parental types of leaves in these respects. The measurements of the stomata is interesting. The numbers of stomata observed through the microscope, and their measurements in microns, are as follows: in wheat 77 with an average length of 52.8 microns; in rye 78, average length 46.5 microns, in F_1 hybrids 96, average length 47 microns. The maximum number of stomata of the F_1 hybrids was 110 (maximum number in wheat 104) with a maximum length of 73.6 microns, (the maximum noted in wheat is 63.0).

The first year (F_1) seeds were sown in the field and only about 20 per cent of the plants were placed in the greenhouse for the winter, but even under these conditions only 60 or 80 per cent survived. Subjected to a detailed botanical analysis 209 plants gave the following results: two typical rye plants with apparent inclination to self-pollination, seeds being formed even under the parchment packet enclosing the head; 87 plants clearly of the *Triticum* type, but in these frequently were noted several minor morphological features of rye, such as the shoots colored with anthocyanin, lengthening of the flowering glumes, tender awns, carina on the flowering glumes, etc., whereas the forms corresponding to the parent forms were missing. Twelve plants were entirely new forms with long heads, with a large number of spikelets and narrow elongated flowering glumes. In these plants the rye features were predominant, but the empty glumes were many-nerved, and the seed typical of wheat. Finally, 102 plants were placed by us in the

intermediate type, with a larger or smaller number of rye features. All the hybrids, with the exception of two which were typically rye, had wheat seeds and many-nerved empty glumes.

In many hybrids the blooming is not normal. Blooming with widely open flowering glumes predominates; sometimes the anthers do not crack and have a small amount of pollen. A good deal of the pollen is amorphous. In several plants a certain discord in the organs was noticed for example green anthers were thrown out on long threads and then faded, etc.

As regards the fertility of hybrids: typical rye and typical wheat plants in most cases have a normal fertility, but several plants with ears of the square-head type are all sterile. The fertility of the other plants definitely falls as the rye features increase.

The following are the figures for fertility: 29 per cent entirely sterile plants; 42 per cent with one grain each; 11 per cent with normal fertility; the remaining 18 per cent occupy an intermediate position. All the more or less new or original morphological forms are either sterile or bear single seeds.

The new features established are: the narrow, needle-pointed shape of the leaves; thick leaves; great brittleness of the rachis of the ear; very rough awns; thick stems and other features as enumerated above, which indicate a strong deviation from paternal forms.

In the third and fourth generation we have, obviously enough, almost exclusively either typical rye or typical wheat plants, to which we shall confine ourselves, as there were too few hybrids of the intermediate type in these generations. First of all we must point out that F_1 hybrids whether typical rye or typical wheat continue their form into future generations. This constancy, it seems, is characteristic also of the plants of intermediate type. Within these fixed basic forms was noticed only the segregation of individual features. Thus, for example, in one wheat family a simple Mendelian segregation of 1 : 3 occurred with respect to presence and absence of awns; in three families, with respect to hairiness of the upper part of the culm the total numbers gave the approximate ratio 1:15. In other features nothing approximating any fixed segregation could be established.

In the third generation we have 20 per cent entirely sterile plants or with one seed only, and 53 per cent normal plants, sometimes with very good seed.

Now comes the question: If in segregation we notice the separation of two basic forms of the *Triticum* and *Secale* plants, what about those properties which regulate their frost resistance? We are not yet in a position to give a definite answer to this question. Considering the presence in plants of several symptoms of opposing morphological features, we have no reason for denying the possibility of similar phenomena in the physiological properties of the plants. But, so far we must confine ourselves to quoting several appropriate facts.

In the winter of 1920 the hybrid plants were kept in a special hothouse at a temperature of 1°—2° C. This temperature proved particularly favorable for the growth of the fungus *Fusarium nivale*. The hybrids were planted in boxes containing 45 plants each. In one rye family 96 per cent of the plants perished from fungus, and as one box was planted only partly with rye and the rest with another wheat family, we were able to note in the latter the complete absence of attacked plants. The absence of the mycelium of this fungus was noted in four families of the wheat type, in fifty-five families the destructive fungus was present in from seventeen to sixty-two per cent of the plants, and in 113 families there was a slight blight on the plants with but small loss; characteristic segregation was noted in susceptibility to *Fusarium nivale*.

Leaving aside for the time being the question of the difference in susceptibility to the fungus *Fusarium nivale* of the parent forms—a question that has not been cleared up by us—we can, so far, on the basis of the

above facts, make only the statement that among the wheat-rye hybrids segregation was noticed with respect to the effect of the fungus. This fact is in itself sufficiently valuable in the general problem of creating forms of plants resistant to winter injury.

I shall now describe another group of experiments: In the autumn of 1920 we were first able to sow in a field 287 families of hybrids of the third and fourth generations 1 to 10 rows of each, and 25 plants to a row.

The autumn of 1920 was very dry and the sowing had to be done late. Winter then came on early with the result that only the rye type tillered normally; plants of the wheat type tillered hardly at all. The winter was almost without snow. The small quantity of snow that did fall on the fields thawed under the first rays of the spring sun. The parent forms sowed in frequent repetition gave the following results: the wheat perished entirely; on the rye plots up to 23 per cent of the plants perished. Now what happened to the hybrids?

Secale hybrids: in one family consisting of 166 plants only six plants survived, these being evenly distributed over the whole area of the plot. The others perished during the winter. This was not noticed on a single rye plot. The destruction of the plants of this family cannot be explained by the micro-relief of the surface. The plants of this family were characterised by a low spreading growth resembling wheat rather than rye in form of growth. Of the remaining hybrids of the rye type, four stood the winter well like rye. In one family increased frost resistance was noticed, while the remaining 29 families of rye type there was from 36 to 76 per cent destruction.

Naturally then, we arrive at the conclusion that the winter resistance of certain hybrids of the rye type has decreased as the cost of obtaining certain wheat properties.

Triticum hybrids: of the 289 families of the unsatisfactorily developed hybrids, as we said above, but four survived the winter. Subsequently the great majority of the surviving plants perished, as during the days there was great heat, and in the night frosty weather, followed by very dry weather with a drop in the humidity of the air to 20 per cent or lower. Nevertheless, in spite of the extraordinarily unfavorable conditions, we still have at the present time over 300 plants well developed and that have stood all these reverses. At any rate, in this we are able to observe increased winter resistance.

I do not draw any conclusions from the above mentioned facts. Subsequent investigation will undoubtedly make it possible to reach a conclusion on the question that interests us, but I find it necessary to remark that material very limited in its variation was sown in the fields, having a beginning only from 30 F_2 plants, in their turn descended from 30 F_1 plants of such complex constitution as hybrids of wheat and rye, in which are mixed an endless number of different features. It is understood that such a number of plants cannot be in any way considered as sufficient to solve the question on hand.

Life of the Honey Bee

A Book About the Bee, by Herbert Mace. Pp. 138, with 24 illustrations. New York, E. P. Dutton, n.d.

This unpretentious little book, printed in Great Britain, gives a simple and non-technical account of the life of the hive. While the author outlines some of the notable problems pertaining to heredity and evolution among bees, he makes little attempt to suggest solutions for them. As a primer, however, the book should be useful. The photographic illustrations are excellent.—P. P.

THE VIRGINIA OPOSSUM

PHOTOGRAPHS OF TWO NEW VARIETIES AND THE TWO NORMAL PHASES OF THIS ANIMAL[1]

CARL HARTMAN
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THE published descriptions of *Didelphys virginiana* concern themselves almost exclusively with the gray phase shown in Fig. 18 (E and F) in the photographs on the following page. This is the common Virginia opossum. The animal appears gray because the long overhair is white, the soft dense underfur being tipped with black.

Now and then, however, one meets in the literature a casual reference to black individuals such as C and D, in Fig 18. This phase has not received the attention it deserves, for it occurs throughout the range of the Virginia opossum. The National Museum contains numerous black hides; and the writer receives from the Austin region one black to about ten grays. In the black phase the overhair is black, not white, although a few scattered white hairs may be present.

The two phases appear to the writer to be genetically distinct, that is discontinuous varieties, for no gradations between the two have been seen among a thousand animals examined.

In Fig. 18 are also shown two albinotic females received from Kenneth Nevins, Sulphur, Oklahoma. This variety seems to be new, at least the writer is unaware of any existing description of it, although he has heard numerous reports of the occurrence of white opossums in this section of the state. Three or four years ago the writer came into possession of just such an individual, also a female, a photograph of which is included among the illustrations furnished by the writer for the 1921 report of the Secretary of the Smithsonian Institution.

The albinos here shown have all white hair—there is not a single black hair on their bodies. The iris is somewhat lighter than the dark iris of the normal animal, but the eye as a whole appears black, not pink. The skin is black, however, in the usual pigmented areas: feet, ears, base of tail, and the streak between tail and cloacal orifice.

The second variety figured is true brown or "cinnamon." Three individuals are shown, one male (I, Fig. 19) and two females (G and H). These animals were presented by Dr. Chas. McNeil of Sedalia, Missouri, where the variety is said to be not uncommon. Here again the white overhair is either present all over the body, as in G and I, or absent, as in H. This last mentioned female possesses no white overhair; the fur is a uniform and delicate light brown. The specimen ought to produce a commercially valuable strain.

In all of the cinnamon specimens the ears and iris are also brown. This variety has been reported to the Journal of Mammalogy.

The specimens here presented would appear to make excellent genetic material and the appropriate crosses have been planned. Five types are shown, viz.:

1. Gray: black pigment in underfur, no pigment in overhair.
2. Black: black pigment in both kinds of hair.
3. Cinnamon, with brown pigment in underfur, no pigment in overhair.
4. Cinnamon, with brown pigment in both kinds of hair.
5. White: no pigment in either kind of hair.

Three pairs of factors seem to be involved, (1) black versus brown, (2) pigmented overhair versus white overhair, (3) hair color versus white hair.

[1] Contributions from the Zoological Laboratory, the University of Texas, No. 157.

VARIETIES OF THE VIRGINIA OPOSSUM

The two gray animals in the lower right-hand corner (E and F) are representatives of the common Virginia Opossum. C and D are black (the black phase of D. *virginiana*). There are few or no white overhairs in such individuals and they appear to be genetically distinct from the gray. The two animals at the top are albinos. Photos by J. P. Scott and J. M. Kuehne. (Fig. 18.)

THE BROWN OR "CINNAMON" VARIETY OF OPOSSUMS

These animals came from Missouri where they are said to be not uncommon; G and H are females and I is a male. Appropriate crosses have been planned between the five types of individuals shown in the two photographs. G and I have white overhair. H is a female with brown pigment in both underfur and overhair. Photo by Carl Hartman. (Fig. 19.)

HEREDITY DENIED BY BUDDHISTS

Effects of Negative Selection in Oriental Countries

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AN IMPORTANT eugenic principle was stated by Dr. Alexander Graham Bell in the Journal of Heredity for November, 1920, under the title "Is Race Suicide Possible?" No doubt there is more to be learned before we shall have a full understanding of the reactions of "negative selection" as Dr. Bell calls it—"A selection that produces the very opposite of that expected." But Dr. Bell has pointed to some of the effects of this adverse tendency, as it works on the human race, and at the same time has urged a clearer recognition of one of the basic needs in eugenic reform, overlooked by many professing eugenists—the need of enlisting the interest of all forward-minded people in the biological facts of heredity, and in the study of such facts in their relations to human welfare. The practical objects of eugenics are to be gained, if at all, by establishing more normal, biological ideals of life and responsibility in place of the artificial or superstitious notions that so often have turned aside the course of development in the past, even among the most advanced nations.

The negative side of eugenics, as a way of escaping diseases and defects, is interesting to students of special pathological problems, but not inspiring or even attractive to the public at large. Secondary measures for restricting the multiplication of abnormal people may be developed to avoid the difficulty and expense of caring for large numbers of defectives and criminals, but the real foundation of eugenics must be built in the consciousness of intelligent, right-minded people. Of all the impediments and setbacks in human progress, the misguided self-sacrifices of those who have generous intentions for humanity and sensitive feelings of personal responsibility are the most to be regretted.

OVER-POPULATION THE ORIENTAL PROBLEM

Biology is a new science, not only in the sense of discovering new facts, but in reaching new points of view. Not only does the history of European peoples abound in examples of such "negative selection" as Dr. Bell describes, but the same principle is illustrated on a tremendous scale among the crowded populations of the Far East. The fact is most significant that celibacy has been preached for the longest time and most extensively practiced in those countries that nevertheless have developed the largest and most congested populations, to an extent that the rest of the world feels menaced by an "Oriental Problem." Two-thirds of the human race live in the Orient and are dominated by primitive beliefs that conflict, both in theory and in practice, with modern ideas of heredity.

The masses of oriental population are not affected by the "higher tenets" of Buddhism, that call for complete renunciation of life. The primitive "nature religions of Asia" have survived, with their worship of fecundity and requirement of male children to perform ancestral rites, while Buddhism has decayed in spite of its lofty ideal and all-embracing sympathy. The Buddhist theory of salvation by race suicide did not work out in the way that was expected. The history of Buddhism may be an answer to Dr. Bell's question, "Is Race Suicide Possible?"

HEREDITY VERSUS TRANSMIGRATION

To those who are following the progress of genetics, or the modern scientific study of heredity in plants and animals, it may be of interest to know that heredity is challenged as a fact and that even the idea of heredity dismissed as a delusion, by exponents of a great Oriental religion. A conflict is seen between the modern ideas of heredity and the ancient belief in the transmigration of souls, which is the foundation of the Buddhist philosophy of escape from the world of sense. The idea of the soul passing through many successive births, from one stage of creation to another, has at least a superficial similarity to evolution, but the Hindoo idea of birth is different from ours. The infant child, or even the young animal, is not a new creature derived from its parents, but a "soul" that has passed already through innumerable existences, and is now entering another, determined by its merits in the previous stages. The idea of heredity, of a new creature combining hereditary characteristics of the parental families, is not consistent with the belief in "lasting individuality of the soul," through the endless stages of transmigration imagined by Buddhists.

A REVIEW OF BUDDHIST BELIEF

With the belief in transmigration accepted as a fact the whole background of human existence is changed, and all of our usual reckonings reversed. For the genuine Buddhist, life is not a blessing to be prized and developed but a grievous burden to be escaped at any cost, even to a complete negation of all the "values" that we recognize as motives of investigation and progress. It is interesting to follow this complete divergence of Buddhist thought that leads to a denial of the facts of heredity, and seeks an end to "birth-renewal" as the highest good, and ultimate goal of human endeavor.

"*What is Sansara?*

Sansara is the world we live in, the world of illusion, error, guilt, and sorrow, of birth and decay, of endless change, disappointment and pain, of the never-ending circle of transmigration from which no escape is possible until the redeeming light of true knowledge has dawned upon us."

"*What is the cause of sorrow, and of death and birth-renewal?*

The will or desire to live (tanha), inherent in every one of us, the craving for individual existence either in this world or another (Heaven, Paradise)."

"*How can sorrow, death, and birth-renewal be overcome?*

By a free renunciation of the lust of life; by a killing out of the craving for individual rxistence either in this world or another. Therein lies deliverance this is the way to eternal peace."

"*But what is it prevents us from giving up this desire of life and from attaining deliverance?*

Our being ignorant, that is, our want of true knowledge, our want of insight into the real nature of things (avidya)."

"This, brethren, is the grand truth concerning the riddance from suffering: It is the extinction of the lust of life, of the craving for existence: this must be overcome, get rid of, rooted out utterly."

"He who keeps in the path of true holiness, will safely cross this dreary ocean of life, and reach the heaven of eternal peace, where all suffering and all birth-renewal is at an end."

"*What is Nirvana?*

It is a condition of heart and mind in which every earthly craving is extinct; it is the cessation of every passion and desire, of every feeling of ill-will, fear, and sorrow."

"*Is every one able to reach Nirvana in this present life?*

Only the few can do so. Most men, in consequence of their acts in former lives, are morally and mentally so deficient that a great many rebirths or reincarnations are required to purify them ere they can attain deliverance. But whoever is in earnest may be reborn under more favorable circumstances."

"*Is man's birth-renewal only on this earth?*

No; there are countless multitudes of other worlds moving in space, which

are people with beings superior or inferior to man. In every one of these spheres re-incarnation may take place."

"*Are there any evil deeds requiring more than one birth-renewal?*

Certainly; there are such, of which the offender must bear the penalty in a succession of re-incarnations in a lower state."

"*Are the misdeeds of the parents visited on the children*–

No, indeed; no one has to suffer for the wrongs of others; it would be contrary to the laws of eternal justice, whereby guilt and suffering are so closely interwoven that one cannot exist without the other. . . .

It is because we are like our parents in our innermost being, our individuality, that we have become their children, not the converse, as is generally believed; it is because at the moment of our re-incarnation we have greater affinity with them than with any other being, that we have taken flesh from them. Similar causes produce similar effects. The inward resemblance between parents and children must necessarily find its expression in outward form, in inclinations and aversions, circumstances and the like.

The qualities of the parents are never hereditary—in other words, never can be transmitted from parent to child. Heredity is but a name, and the doctrine of Karma and re-incarnation can alone give a satisfactory explanation of the fact that parents and children have many qualities in common.

"*How long does the individuality continue to renew itself in repeated births?*

Until perfect knowledge and Nirvana is attained. Then, and not till then, is that haven of rest attained where there is no more suffering, no more death, birth-renewal, or individualism."

Most people are born again; evildoers go to the dark worlds, righteous people go to a bright state. Those who are free from all fetters and worldly desires attain Nirvana—they are never born again.

The doctrine of re-birth or reincarnation is the most ancient and venerable truth possessed by mankind. It is that primitive religious sense of which we seem to have an innate knowledge unless prejudices and errors have been instilled in our minds from early youth.[1]

MENTAL ABSTRACTION OF THE HINDOOS

How a primitive people might develop the idea of transmigration is not difficult to understand. From the general belief of savages that the soul wanders away from the body in dreams and comes back again, it is only one step to the belief that should wander after death and enter the bodies of the next children that are born to the tribe. The savages may be interested only to the extent of recognizing dead friends or enemies in their children, but with the Hindoos the idea of transmigration became a fantastic, overwhelming obsession. The oppression of the belief in endless rebirths is what the Buddhist hopes to escape, through celibacy and denial of human ties. An utter indifference to all human interest is the Hindoo's ideal of perfection, which he sacrifices everything to attain. He looks on human existence as a field of punishment, and the world of living creatures as a purgatory where the souls of dead men are passing through endless processes of retribution, working out through "laws of eternal justice," toward new births in human form, with the idea of complete detachment of the "soul" the only hope of escape. It is little enough that the Buddhist hopes for, but anything is better than the nightmare world of the primitive Hindoo beliefs. According to Buddhists,

"The soul, disentangled from all that exists, finds itself alone without any object it can adhere to; folding itself up into its own being, it remains in a state of internal contemplation, desti-

[1] Extracted with slight rearrangement of paragraphs from "A Buddhist Catechism . . . for the Use of Europeans," by Subhádra Bhikshu, New York, 1920.

tute alike of all active feelings of pleasure and pain."[2]

Thus the Buddhist ideal is utterly remote, at the opposite pole of thought from the eugenic ideal voiced by Goethe: "To live that nobler souls come after, highest aim that man has sought."

BELIEF IN REINCARNATION A DENIAL OF PARENTAL RESPONSIBILITY

No doubt it becomes easier to apply the Buddhist doctrine of suppressing family instincts, for those who can persuade themselves that heredity is "but a name." Ties of birth and blood can have no such meaning as for us, among those who look upon their children as products of "reincarnation," with no transmission of parental qualities. It is difficult to see how any sense of eugenic responsibility could develop under the Buddhist belief that defective or diseased children are suffering necessary penalties of misdeeds in former lives.

The family ties have held, of course, with the masses of the population, notwithstanding the intellectual supremacy of Buddhism, and its persistent influence, leading thousands of the more capable members of each generation to seek "salvation" through self-elimination. Though Buddhists revolted at first against the idea of caste, it is easy to understand that the doctrine of transmigration, denial of family relationships and withdrawal from human interests, as accepted and enjoined by Buddhists, might intensify the spirit of aloofness, and thus contribute to the extreme development of caste among the Hindoos.

"We doubt if any European ever fully realizes how great the mental effect of the segrativeness, the separation into atoms, of Indian society, continued, as it has been, for three thousand unbroken years, has actually been. We speak of that society as 'divided into castes,' but it is, and has always been, divided into far more minute divisions or crystals, each in a way complete, but each absolutely separated from its neighbor by rules, laws, prejudices, traditions, and principles of ceremonial purity, which in the aggregate, form impassable lines of demarcation. It is not the European to whom the Indian will not reveal himself, but mankind, outside of a circle usually wonderfully small, and often a single family, from whom he mentally retreats. His first preoccupation in life is to keep his 'caste,' his separateness, his ceremonial purity, from any contact with any other equally separate crystal; and in that preoccupation, permanent and all-absorbing for thousands of years, he has learned to shroud his inner mind, till in revealing it he feels as if he were revealing some shrine which it is blasphemy to open, as if he had earned from Heaven the misfortune he thinks sure to follow."[3]

Some writers have interpreted the Hindoo religiosity as a great national virtue, and others as a racial defect or limitation, that kept the Oriental philosophers wandering in the desert of speculation, away from the field of science. Max Müller would set the Hindoos on a high pinnacle of contemplative virtue, while others see the Hindoo mind as self-imprisoned in a structure of elaborate but futile ideas, dreaming, at once fantastic and futile.

"The southern Aryans were absorbed in the struggles of thought: their past is the problem of creation, their future the problem of existence, and the present, which ought to be the solution of both, seems never to have attracted their attention, or called forth their energies. There never was a nation believing so firmly in another world, and so little concerned about this. Their condition on earth was to them a problem; their real and eternal life a simple fact. . . . * * * The only sphere in which the Indian mind finds itself at liberty to act, to create, and to worship is the sphere of religion and philosophy, and nowhere have religious and metaphysical ideas struck root so deeply in the mind of a nation as in India. History supplies no second

[2] Bigandet, P., 1911. The Life or Legend of Gaudama, 1:127.
[3] Meredith Townsend, "Asia and Europe," 1901, p. 153.

instance where the inward life of the soul has so completely absorbed all the other faculties of a people."[4] In utter contrast with this view is that of a recent writer who sees the Hindoo mind imprisoned in a world of elaborate dreaming, at once fantastic and futile.

"Indeed, what we have called the Hindu philosophy is more than a philosophy; it is a racial tendency and profound mental bias, and its dominating influence is, as has been already pointed out, written across the whole page of Indian history. For there is this that is sinister about the Eastern contemplative philosophy, that it cuts away the ground from under the feet of all natural knowledge of whatever kind. India's only teachers, her only professors are those solitary dreamers who remote from books and all the paraphernalia of research, commune with the infinite in their own souls. India has built up no edifice of mundane knowledge and appears in all ages to have been totally regardless of all merely intellectual achievement. She is not interested in the world we live in, and knows little or nothing about its anatomy and its laws. She is not interested in man, and knows little or nothing about his history and exploits. . . .

"India, in short, has never made anything of either art or mundane knowledge because Indian philosophy from the first has met the claims of Nature with a flat negative. The first Indian seers who started the race on a spiritual career, of which the denial of material existence was an essential condition, laid the axe to the root of all art as well as all secular science of whatsoever kind."[5]

PROGRESS OF CIVILIZATION RETARDED BY HINDOO EVASION OF THE PROBLEM OF LIFE

So much for India; but the influence of Hindoo abstraction, life-weariness and asceticism may be traced much more widely, not only in oriental countries, but in Western civilization. And everywhere these tendencies are a menace, or at least an impediment in the way of progress, in turning the interest of intelligent and well-intentioned people away from the concrete, constructive problems of human life, to seek some other "salvation" in a world of abstract, speculative "thought." If the problems are difficult, the more need of facing them directly instead of seeking a "way of escape." Surely it is a strange perversion of the mind, and essentially a superstitious perversion, that leads men to turn their back on the actual "world of the senses" and give their lives to the elaboration of a world of dreams, as in denying heredity and holding to transmigration.

FACT OF HEREDITY A DIRECT CAUSE OF EMANCIPATION OF WOMEN

Another time-honored Oriental belief that gives way before modern knowledge of heredity is that of generation as a male function exclusively, an idea that explains why descent came to be reckoned exclusively in the male line. Likeness of children to mothers was explained by "prenatal influence," not by inheritance as from the father. This theory or superstition undoubtedly contributed to the subordination of women among the Oriental nations, as well as among the Mediterranean peoples. The emancipation of woman comes as a natural consequence of our modern scientific knowledge of the fact that the mother is an equal parent of the child.

RELIGIOUS FANATICISM AND THE ORIENTAL PROBLEM

Release of the Oriental nations from the limitations imposed by their native systems of government and religious belief is a momentous change, and to many students and statesmen appears to threaten the very existence of Western civilization. Instead of "The Commercial Prize of the Orient," "The Rising Tide of Color" is now in the bookstores. The commercial European nations, after forcing themselves

[4] Müller, Thoughts on Life and Religion, pp. 77-78.
[5] Phillipps, Lisle M. Form and Colour, p. 104-105, 1915.

through the barriers of Oriental exclusiveness, are alarmed by the "pressure of population" that begins to pour out, much as the poor fisherman of *The Arabian Nights* was terrified by the genii that came out of the bottle picked up on the seashore.

Exclusion of Asiatic immigrants from a few countries is no solution of the general Oriental problem. If the reproductive pressure of the Orient is to continue even for a few centuries, it is clear that the world must be Orientalized, simply by natural increase. Control of the Orient by the European nations results in a more rapid increase of population than under the less efficient native systems of government. The real danger is not that of immediate military aggression from Japan or other oriental countries, but the gradual, peaceable, passive extension of the oriental races, who have developed and adapted themselves to a kind of existence that enables them to undermine and destroy other forms of civilization, and destroy or absorb other races.

Hence it is a problem of heredity, or at least of biology, to recognize, explain, and if possible to find means of controlling this Oriental over-production. The point raised by Dr. Bell obviously is important, and may prove fundamental. If Dr. Bell's argument is well founded, and it is true that a failure of the more capable elements of a race to leave posterity tends to an excessive production of the less capable, it may be easier to understand the present conditions in Asia, and the problems that the Oriental contacts are now forcing upon the Western nations. If Dr. Bell is right, the over-population, poverty, degeneration and misery of the oriental countries may be traced to the Buddhist doctrines that tend to race-suicide among the superior elements of the oriental nations, and to excessive multiplication of the less capable.

GENERAL INFLUENCE OF HEREDITY

Knowledge of heredity may have epoch-making importance in its reaction upon the human mind, quite apart from any applications of heredity in breeding and eugenics. The value of science in liberating the mind is second only to the utility of direct applications, and sometimes the indirect results are the more important. Nothing was changed directly by proving that the earth moves with the other planets around the sun, instead of being the center of the celestial system, but the progress of astronomy had an enormous effect in stimulating the general advancement of learning. Science has been described as "common sense," but this is misleading. Science is not the common sense of generally accepted opinion, but has for its primary object the study of new facts, that have not figured in the common sense of accepted opinion—facts that are "scientific" because they increase knowledge. After the new facts are recognized and assimilated into the body of knowledge, the common sense is changed, because people do not consciously and intentionally disregard facts. Beliefs are held easily against doubts, or contrary opinions but not against ascertained facts.

KNOWLEDGE OF HEREDITY LEADS TO APPRECIATION OF INDIVIDUAL RESPONSIBILITY

The facts of heredity, when they are sufficiently known, must have a very profound influence, by making it impossible for well-intentioned, high-minded people to be hypnotized by superstitious ideas, and made insensible to primary considerations of human welfare. It is the suicide of the mind that causes suicide of the body, and leads to the "race-suicide" of those who are made to believe that some other interest is more important, some action more righteous, some duty more exigent, than marrying the right wife and raising the right children. As Dr. Bell has told us, this kind of high-motive race-suicide defeats its own purpose, in ways that the high-minded people have not taken into account. To exalt celibacy is to debase woman by seeing her as a snare of evil instead of

an equal partner in the highest responsibility of life. Chastity is a virtue of high ideals of life, and of loyalty to our unfound mates and our unborn children, but celibacy as a doctrine of life is based on a perversion of ideas, and often of instincts as well. The fallacy is proven by the result that celibacy works the wrong way in relation to the world's history, not for human progress, but toward degeneration of the race.

The calamity that Roosevelt recognized and deplored as race suicide was the failure of so many well-to-do and capable people to marry and raise families. The term race suicide may be somewhat misleading, since deterioration of quality is a more serious danger than numerical reduction, but the essential fact should not be obscured, that a process of negative selection is going on, to the detriment of the race, and that the population of a country may go on increasing, as in the Orient, while the quality of the race and the conditions of existence may decline, until a limit of disaster is reached. The causes of some forms of negative selection may be found in the artificial beliefs or misvaluations that lead the capable people to sacrifice their family instincts to some idea, interest, or activity that is supposed to be more important.

It is evident from this dangerous tendency that people need to be racially right-minded as well as capable and dutiful in individual relations. Moreover, it is becoming apparent that this biological, eugenic right-mindedness is not being advanced by our over-developed system of education, which tends strongly to sterility, not through any direct teaching of celibacy as an ideal of existence, but by deferring marriage and making the educational responsibilities of parents appear too heavy for prudent people to undertake. Though celibacy is not taught as a religious motive or philosophical ideal, the effect is the same, to reduce and eliminate the more capable stocks and leave the less capable to "replenish the earth." "In New England a century has witnessed the passage of a many-child family to a one-child family. The purest New England stock is not holding its own. The next stage is the no-child marriage and the extinction of the stock which laid the foundations of the republican institutions of this country."

COLOR OF CROSS BRED CALVES

What will be the color and form of a cross bred calf of the Jersey and Holstein breeds? We have notes on six such calves. Five of the calves were sired by our Holstein herd bull that is half black and white. The first calf was out of a high grade Jersey cow, a fawn in color. The calf was a solid black. The second calf was out of a grayish cow, a high grade Jersey, and the calf was solid black. The third calf was out of a pure bred Jersey cow of yellow fawn, and the calf was marked like a Holstein. It was half white and black. The fourth calf was out of a fawn cow, grade Jersey, and the calf was black on the body with white legs. All of the grade Jersey cows were almost pure bred, and had no Holstein blood in them. The fifth calf is out of a pure bred Jersey cow that is a reddish fawn and the calf is half white and black like a Holstein. A grade Holstein cow that is black, mated with a Jersey bull produced a solid black calf.

Thus it seems that the Jersey color is entirely recessive to the Holstein color as the fawn did not appear in the calves from Jersey cows and a Holstein bull, nor from the reciprocal cross of a grade Holstein cow and a Jersey bull. Half of these calves were solid black, one had a black body and white legs and two were marked like a Holstein, white and black.—*J. J. Hooper, University of Kentucky.*

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Genetics and Eugenics

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"An exact determination of the laws of heredity will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen.

"To gain this knowledge is the object of the science of genetics, which proceeds in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race, through the science of eugenics."

In the world's life of today it is a duty and a responsibility to be interested in the great questions of inheritance, and to possess a working knowledge of the methods for the improvement of living things. Consider the importance of this in your own life, and in the lives of those about you. The Association welcomes into its membership all those who are influencing the thought and progress of the present, and the young people who are going to be the thinkers and leaders of the next generation.

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AUTHENTIC information on the great questions of heredity is more in demand now than ever before. Every thoughtful person desires and needs to know the fundamental facts of inheritance.

The number of investigators who are creating new forms and improving old forms of our plants and animals is increasing all the time, and each discovery opens the way to some additional field of profitable human industry.

Much of our present-day charity is palliative only and can be nothing else until we recognize that many of the causes of distress or misery are in heredity. The studies of inheritance in man are indicating new lines along which the vast giving of charity must be directed.

There can be no better way of encouraging young people to think correctly about these problems than to make them members of this Association and place before them the JOURNAL OF HEREDITY with its illustrated articles from the pens of the men who are actually making the discoveries.

Is not the holiday season an especially suitable time for members to think of this service they may do for their friends and associates, and extend this vital branch of human knowledge?

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